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ON THE NATURE AND TREATMENT

OF THE

DISEASES OF THE HEART

CONTAINING ALSO SOME

NEW VIEWS ON THE CIRCULATION OF THE BLOOD

WITH

AN ACCOUNT OF THE MUSCULO-CARDIAC, THE PULMO-CARDIAC,
AND THE VENO-PULMONARY FUNCTIONS.

BY

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SOCIETY OF BERLIN, AND OF THE MEDICAL SOCIETY OF LEIPSIC,
ETC. ETC. ETC.

A New Edition, carefully Revised, with considerable Additions.
AND A COPIOUS INDEX.

EDINBURGH: THOMAS CONSTABLE AND CO.
HAMILTON, ADAMS, AND CO., LONDON.
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TO

JAMES Y. SIMPSON, M.D.,

PROFESSOR OF MIDWIFERY IN THE UNIVERSITY OF EDINBURGH,
ETC. ETC. ETC.

I dedicate this Book to you, because you are one of the most distinguished Members of your Profession, and one of the greatest benefactors to mankind. Your untiring assiduity, your unwearying zeal, and the genius which you have shown in the advancement of the Healing Art, justly entitle you to the esteem of medical men; and the discovery of Chloroform, as a wonderful means of assuaging human sufferings, has gained for you the everlasting gratitude of your fellow-beings.

I am also glad to have an opportunity to express the high sense which I entertain of your philanthropy, of your beneficence, and of your many private virtues; and it is a particular source of pleasure to me to think, that it should have been on the same spot of that land as yourself wherein I drew the first breath of life!

In offering to you this tribute of regard, let me express an earnest hope that you may be long enabled, by your precepts and by your example, to adorn a Profession with which the happiness and interests of humanity are so intimately associated.

JAMES WARDROP.

Charles Street, St. James' Square,
1851.

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PREFATORY ADDRESS.

Before entering upon the consideration of the diseases of the heart, and in order to illustrate some important pathological phenomena connected with the circulation, and also with the function of respiration, I propose, in the present work, to draw the attention of the reader to some points in the anatomy of the circulating apparatus, and to certain functions of the heart; by a knowledge of which, I am confident, many disorders, not only of the heart, but also of the respiratory and nervous systems, may be satisfactorily explained, and rational principles for their treatment established.

Whilst prosecuting some investigations concerning the diseases of the heart, and more particularly their causes and treatment, my attention was directed to certain symptoms, with which various affections of that organ are accompanied. In seeking an explanation of them, I was led to reflect on several natural phenomena connected with the circulation of the blood in the heart, and with the function of respiration, of which no satisfactory explanation had hitherto been given, and to some of which no allusion had even been made, in physiological writings.

I was particularly struck with the influence of respiration on the action of the heart, and with the influence of the action of the heart on respiration, as well as with all the modifications of these functions, not only in diseases, but likewise during the acts of weeping, sobbing, crying, laughing, sneezing, yawning, and vomiting; of all which instinctive acts scarcely any notice, far less any satisfactory explanation, is to be found either in physiological or pathological works.

I was also led to inquire how it is that the giddiness in turning round rapidly, in swinging, and in sea-sickness, should be felt by some persons and not by others.

Having arrived at the conclusion that these various phenomena are intimately connected with the great function of the circulation of the blood, further observations convinced me that each of them is an *instinctive act*, employed for performing a specific purpose in the economy; some for increasing, and others for diminishing, the quantity of blood within the thoracic cavities, according as modifications in its quantity may be required, or an adjustment necessary in the different organs for the due performance of their respective functions.

My attention was no less arrested when contemplating the influence which the almost constant movements of the body produce both on the respiratory and circulating organs. I was led to inquire, how the action of the heart and lungs is increased by violent exercise; how persons can, by a process of "training," acquire the power of using their muscles, until the muscular energy is exhausted, without causing breathlessness, or a sense of suffocation; in what the art of "diving" consists; and, finally, how diseases of the heart are caused by violent muscular exertions, as well as by mental excitement.

In pursuing these investigations, I was conducted step by step to establish three important functions—functions connected with the circulation of the blood, which had hitherto been altogether overlooked by physiologists.

First, that the *muscles*, besides being the organs of active locomotion, powerfully influence the circulation in the arteries as well as in the veins, thus performing the important office of increasing the quantity of arterial, as well as of venous blood, within the cavities of the heart.

Secondly, that the *lungs*, as a reservoir, regulate the supply of blood to the heart, and thus prevent congestion within the heart's cavities.

Thirdly, that the *sub-cutaneous veins* perform the office of a reservoir, and prevent congestion within the pulmonary vessels.

The first of these functions I have denominated the *musculo-cardiac;* the second, the *pulmo-cardiac;* and the third, the *veno-pulmonary* function.

By establishing the existence of these important functions of the organs of active motion, of the lungs, and of the veins, several phenomena, both of the respiratory and circulatory organs, will, I am confident, admit of a very satisfactory explanation, and enable us to account for some peculiarities in the structure and arrangements of the vascular system; whilst they will also materially assist in elucidating many phenomena in the diseases both of the organs of circulation and respiration.

From the supposed dangerous tendency of all the diseases of the heart, it might have been anticipated that the various affections of that organ would have been carefully investigated, even from a very early period in the history of medicine; but the erroneous impression which has been too generally entertained of the limited powers of medical treatment in the diseases of the heart, as well as the equally erroneous impression of the fatal character of these diseases, would seem to have paralysed rather than to have excited inquiry into this most interesting branch of medical science.

Morgagni, Senac, Baillie, Burns, and others, have contributed much to advance our acquaintance with the pathology of the heart. The subsequent researches of the French pathologists, more especially those of Corvisart, Laennec, Bertin, Andral, and Bouillaud, by pointing out additional means of recognising, during life, some of the morbid changes of structure which previously could be detected only after death, materially contributed to the advancement of this department of knowledge.

It, however, still remains an important desideratum to discover the means of discriminating the diseases of the heart, more especially in their earliest stages, and before any of those formidable changes of structure have taken place, which it is not within the powers of medicine to control. It is quite evident that such changes of structure must be preceded by a train of phenomena—by a series of lesser disturbances in the function of the heart—the detection of which would enable us to apply remedial means with a probability of achieving the same advantages as are derived in the treatment of diseases in other organs.

To these investigations my attention has been long directed; and I am not without a hope that the explanation which I am about to give of the nature and causes of some of the *functional* diseases of the heart, and the additions made to the catalogue of their symptoms, together with the principles laid down for their treatment, will not be deemed unimportant. It is, indeed, surprising that the functional disorders of the heart have met with scarcely any consideration from the numerous authors who professed to treat of the diseases of this organ. "It appears to me," very justly observes Barlow, when alluding to the importance of attention being directed to functional diseases in general, "that to such early periods of disease attention may be most beneficially directed; and that, whilst we continue to avail ourselves of the accumulated experience of ages in treating the more advanced stages, it is incumbent on us to extend the boundaries of the science we profess, by more completely investigating the earliest approaches, and thus illustrating those early and important periods of disease in which medical treatment may be of most avail."[1]

Of no inconsiderable importance will, I trust, be found the observations I am about to make on the general or *physiological* symptoms of the diseases of the heart; a subject on which far too little attention has been hitherto bestowed. Though Laennec had the merit of throwing much light on the pathology of this organ, and of stimulating others to pursue the same investigations, yet many of his followers seem to have been intoxicated with the idea of being able to form a correct diagnosis by observing merely the physical signs of the heart's diseases, entirely disregarding the physiological symptoms, or those symptoms which arise from changes in the various systems and organs of the economy, produced by alterations in their supply of blood, from a disordered action of the central organ of the circulation.

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[1] *Edinburgh Medical and Surgical Journal*

The observations which I shall have to make on *therapeutics* will, it is hoped, merit the consideration of practical men. The medicinal substances, which have a specific effect on the action of the heart, I have arranged together; for it is singular that, whilst classes have been assigned to sudorifics, diuretics, purgatives, &c. &c., no author has classified those substances which act upon the organs of circulation. Ipecacuanha, as is well known, acts upon the stomach; saline medicines on the small, and aloes on the large, intestines; mercury influences the functions of the liver and salivary glands; cantharides and the various balsams operate on the urinary organs; neurotics act on the brain, and some even on particular nerves, as belladonna on the nerves of the iris. In like manner, the preparations of antimony, of iron, of copper, of lead, and also certain vegetable substances, as digitalis, colchicum, hellebore, and tobacco, have each a particular influence on the functions of the heart. It is not, therefore, too much to affirm, that the power of recognising diseases of the heart in their early stages will, with the judicious exhibition of these cardiac remedies, enable us to treat the diseases of that as successfully as those of any other organ.

The materials of which this work is composed have been collected and arranged during those intervals of repose which are but sparingly allotted to those who are engaged in the anxious and laborious duties of a professional life. I have, therefore, been compelled to limit my investigations chiefly to those diseases which I have had ample opportunities of observing, and avoided dwelling upon such maladies as have been fully treated of by others. However imperfectly some of the subjects are discussed, and however much, by time and industry, they might be made more worthy of being brought before the profession, yet I have a strong conviction of the danger of delay, and of the evil of being too anxious to render a work more perfect than circumstances are ever likely to permit. Impressed, too, with the uncertainty of human life, and also of the continuance of intellectual vigour, I am induced to offer the work to my professional brethren in its present state, and must apologize for the numerous defects, and for the too general manner in which some of the topics are discussed: for, although I have been many years employed in collecting and condensing the materials of these pages, yet on a subject so comprehensive as that on which I profess to treat, whatever industry I have employed, the field of inquiry is far too extensive to be satisfactorily explored by any one individual.

Much indulgence may surely with justice be claimed by those who, towards the close of a long and busy life, devote a portion of their time to record the results of their experience and observation; and it is much to be regretted that, in a practical profession like that of medicine, so many of our most distinguished brethren have not left behind them even the most trifling memorial of all their labours; a circumstance much to be deplored in the lives of professional men, and which results, perhaps, too frequently from the desire which most of us feel to undergo less mental exertion and fatigue, and to enjoy more tranquillity and repose, as we advance in the vale of years.

PREFATORY ADDRESS TO THE SECOND EDITION.

I am encouraged to present to my professional brethren a new edition of this work, as the doctrines upon which it is based have not, as far as I am aware, been disputed; but, on the contrary, have received the sanction of numerous competent and impartial judges.

I have spared no pains in revising this new edition, and have made many additions for the better illustration of some of the more important subjects.

The views which I have taken on many subjects, and the conclusions deduced from these views, may be opposed to many preconceived notions, especially as regards the causes of several disorders of the heart, and the diagnostic signs indicated by changes in the sounds of the heart; it cannot, therefore, be expected that all those who have long entertained views different from mine will readily adopt new doctrines. The most important discoveries, both in science and in the arts, have always been received with great jealousy by the generality of mankind, and years rolled on before their value was appreciated.

Of this repugnance to adopt new doctrines in medical science there is a striking example in the discovery of Harvey—a discovery which has gained for its author immortal fame. Of him, it is told by his biographers, that no man above the age of forty gave credence to his account of the circulation of the blood. Speaking of his discoveries, Harvey observes, "These views, as usual, pleased some more than others; some calumniated me, and laid it to me as a crime that I had dared to depart from the precepts and opinions of all anatomists; others desired further explanations of the novelties which they saw were both worthy of consideration, and might perchance be found of signal use."

Here I may briefly allude to some of the more important subjects, physiological, pathological, and therapeutical, treated of in this work.

What I have said of the anatomy of the organs of circulation relates chiefly to some parts of the structure, and to some arrangements of the vascular system, which, though long known to anatomists, yet their purposes have never been explained.

Of these the *coronary arteries* are an example; the peculiarities of their origin, course, and distribution, illustrate the means which the economy employs to secure for these vessels whatever quantity of blood the tissues of the heart may require.

I have also endeavoured to show that the remarkable peculiarities in the arrangement of the *cerebral arteries*, more especially the course of the vertebrals in bony canals, have an essential influence on the circulation of the blood in the head: of this singular vascular arrangement no rational explanation has hitherto been given.

No less important is the fact that, in the circulation of the cerebro-spinal system, the whole prolongation of the spinal cord, as well as the brain itself, is supplied with blood from the same channels; the spinal arteries coming off from the vertebrals after these vessels have entered the cranium: this affords a striking proof of the unity of the nervous system.

Another important arrangement in the arterial system, to which I have particularly alluded, is, that some arteries are exposed to more or less *muscular pressure*, whenever the muscles to which they are contiguous contract, and consequently the passage of the blood through them is intercepted; whereas there are other arteries which are so placed in relation to the muscles that the transit of the blood through them cannot be influenced by their contractions.

By this position of some arteries, certain muscles, besides being the organs of active motion, not only *propel* the venous blood to the right heart, but likewise *impede* the exit of the arterial blood from the left heart.

This function, which I have denominated the *musculo-cardiac function*, and which I think I have clearly established, will satisfactorily explain many phenomena of the circulation, the purposes of which in the animal economy, whether in health or in disease, had never been previously noticed by physiologists.

There are likewise arrangements in the *venous* system, to which I have alluded, by which some important offices in the venous circulation are performed; these arrangements explain many phenomena both of the respiratory and circulating organs, as well as of the disorders of the right heart. Thus some veins are placed in relation to the muscles so that the pressure of the adjacent muscles, when contracted, increases the momentum of the venous blood; and there are other veins which are so arranged, that the circulation of the venous blood in them is not influenced by any muscular contractions. An important arrangement of the venous system is the *plexus*, and also the enlargement and the *tortuosities* of some veins, which not only in man, but in certain tribes of animals, serve as *diverticula* or reservoirs to guard not only the heart, but also the lungs and the brain from congestion.

It may, indeed, be affirmed, that a knowledge of the *musculo-cardiac*, the *pulmo-cardiac*, and the *veno-pulmonary* functions, has opened a new field both of physiological and pathological research; and it is upon the existence of these important functions that this work is chiefly based.

These functions satisfactorily explain how a due balance of the circulation in the various organs is maintained, and how the connexion of the three vital organs, the heart, the lungs, and the brain, are, through the medium of the arterial and venous blood, so intimately associated.

To explain some of the primary disorders of the *cardiac nerves*, as well as some of the *sympathetic* affections of the heart, I have shown that the heart is endowed with a *special nervous centre*—a physiological fact which is corroborated by the anatomy of the nervous system of various classes of animals, as well as of man.

On the *physiological symptoms* of the disorders of the heart I have dwelt at considerable length, and have pointed out, not only many symptoms derived from changes in each of the different systems of the animal economy, caused by changes in the *quantity* of their blood, but have noticed also many symptoms which arise from changes in the *qualities* of the blood, by which symptoms a correct diagnosis of the heart's diseases may be established, and which symptoms have never been alluded to by those who have professedly written upon the diseases of the heart.

The inquiries into the physiological symptoms led me, step by step, to discriminate some disorders of the heart of which no mention had hitherto been made. Of these several are functional diseases; some of them arise from a morbid condition of the blood; others are caused by a congestion of blood within the cavities of the heart; some are seated in the coronary vessels; and some arise from primary, and some also from sympathetic, affections of the cardiac nerves.

Finally, I have entered at considerable length into an explanation of a *gouty inflammation* of the heart; a disease by no means unfrequent, but of which no accurate account has ever been hitherto given.

I have also noticed the serious errors, as well as the sources of these errors, which have been made by those who have assumed that the disorders of the heart can be accurately recognised by physical signs, especially by observing changes in the *audible sounds* of the heart.

I have likewise pointed out some unphilosophical explanations, which have been given of the causes of certain sounds in diseases of the heart, especially that explanation which attributes a certain sound to the "flapping of a valve;" thus attempting to explain a hydraulic phenomenon by the laws of acoustics. Equally untenable is the notion that "a sound of friction" could be derived from the rubbing of the surfaces of the pericardium upon each other, when these surfaces were covered with coagulated lymph.

Without noticing the discrepancy in the opinions and in the experiments of those who have endeavoured to explain the causes of the sounds of the heart, no stronger proof can be given of the errors of such doctrines than the fact, that the same morbid sounds are met with both in diseases of the tissues of the heart and in disorders caused by changes in the quantity and in the quality of the blood passing through the heart's cavities; and, above all, as I have shown that there are diseases of the heart which had not been described by any previous writer, consequently whatever sounds may have been elicited in such diseases must have been erroneously referred to other diseases of the heart.

Without entering into a discussion on the contradictory opinions which have been offered upon the causes of the two audible sounds of the heart, I have shown that these sounds, like the sounds observed in an external *aneurism*, must arise from changes in the currents of the blood; and as the currents of the blood are synchronous, the one with the systole and the other with the diastole of the heart, the two sounds must therefore be caused one by the current of the blood passing from the auricles into the ventricles, and the other by its passing from the ventricles into the pulmonary artery and the aorta.

I have shown, too, that the principle on which the *stethoscope* has been made is erroneous, and have pointed out how it ought to be constructed.

I have, at some length, considered the *therapeutic* measures which are applicable to the treatment of the diseases of the heart, and have dwelt on the importance of taking Nature as our guide, and of imitating the curative processes which she employs, thus following the rules laid down by the "Father of Medicine." In accordance with this great therapeutic principle, it will appear that the various chemico-vital, as well as the mechanico-vital processes, which are applicable to the treatment of the diseases of the heart, are all in strict imitation of those principles which are employed by the *vis medicatrix naturæ.*

In embodying the materials of this work, I have followed certain rules. Condillac recommends us to give the result of our observations in the order in which they were made, leaving the reader to judge whether the theory flowed naturally from the facts, or whether the recorder of the facts appeared to be influenced by a preconceived theory. In accordance with this rule, I have not attempted to draw any inductions which did not logically follow from a careful observation of the phenomena of Nature. Future inquirers will, no doubt, reveal more fully the laws which regulate the human body, both in health and in disease. But, as Hippocrates truly observes, "the brevity of human life is insufficient for the full consideration and thorough knowledge of a science like medicine."

Throughout the work I have avoided, as much as possible, employing *new names*, especially when they did not signify new things. The vast number of terms which have been of late years introduced, particularly by foreign authors, tend only to embarrass medical science, and to render the attaining a knowledge of it more difficult. "In composing systems which explain the laws and phenomena of Nature, and where the chief object of the reader is to increase his knowledge, all that should be expected from the author is perspicuity, and the rejection as much as possible of all technical phraseology and scholastic terms."[1]

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[1] BARRON'S *Lectures on Logic.*

Like the author of *Cosmos*, I have never hesitated to quote from works of history and fiction any observations which appeared to illustrate the subject under discussion.

The same enlightened philosopher has dwelt with great force and eloquence on the pleasure and instruction to be derived from a contemplation of the inorganic world. The external crust of the earth, with its mountains and its forests, the waters of the ocean, and the starry firmament, alike awaken our admiration and our wonder; but no less forcibly are we impressed with the beauty and design in the structure of organized beings; and surely equal, if not more, pleasure and useful knowledge may be derived from the contemplation of the wonderful structure of the animal creation!

To conclude, I may say, in the words of our great philosopher Locke, that "truth has been my only aim, and wherever that has appeared to lead my thoughts I have impartially followed it, without minding whether the footsteps of any other lay that way or no; not that I want a due respect to other men's opinions, but, after all, the greatest reverence is due to truth; and I hope it will not be thought arrogance to say, that perhaps we should make greater progress in the discovery of rational and contemplative knowledge, if we sought it in the fountain, in the consideration of things themselves, and made use rather of our own thoughts than other men's to find it."[1]

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[1] LOCKE'S *Essay on the Human Understanding.*

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CHAPTER I.

THE STRUCTURE AND FUNCTIONS OF THE HEART.

The number of the heart's functions; their peculiarities; the size of the heart; the capacity of its cavities; the two hearts; the two bloods; the quantity of the mass of blood; comparative quantity in the arteries and veins; the two circles of the blood; the two audible sounds; the tilting of the heart; the impulse caused by the tilting; the fibro-cartilaginous tissues; the valvular apparatus of the two hearts; the pericardium and the endocardium; the coronary arteries and veins; the muscles of the heart; the nervous system of the heart.

The functions of the heart.

THE heart performs no less than four distinct functions, for each of which a special apparatus is assigned. As a reservoir, it receives the blood within its different cavities, it mixes the two bloods—which it receives from the cavæ veins like a churn—it propels the blood into the arteries like a syringe,—and it directs the vital fluid into the proper channels, by the peculiar form of its internal surface, the position of its valves, and the "tilting" of its apex. It is neither an organ of secretion nor of excretion; and there is scarcely any other organ whose functions are so purely mechanical as those of the heart. "The heart is truly a mechanical engine; for, although the muscles are the powers in an animal, yet these powers are themselves often converted into a machine, of which the heart is a strong instance. From the disposition of its muscular fibres, tendons, ligaments, and valves, it is adapted to mechanical purposes, which make it a complete organ or machine in itself." But in contemplating the phenomena of the circulation, we must carefully discriminate those functions of the heart which are purely physical from those which are vital.

Their peculiarities.

John Hunter.

The size of the heart.

In *size* the heart varies exceedingly, not only at the different periods of life, but also in different persons. "According to the size of the heart, so it has been supposed that a man is strong or weak, and that he has more or less moral courage. The heart is more powerful in courageous animals than in the feeble and in the timid. Hence the common expression of a person having 'the heart' to make any great effort."

Richerand's Physiology.

The capacity of the heart.

The *capacity* of the cavities of the heart changes much, in the varied conditions of the circulation. They certainly expel and receive more blood at one time, than at another, the velocity of the stream being increased or diminished according to the heart's vigour. Neither does the heart expel, by each of its contractions, the whole of its contents; nor does it receive, each time it dilates, all the blood which its cavities are capable of containing. Like the lungs, which are never empty, and in which the quantity of atmospheric air inhaled by each inspiration, and expelled by each expiration, is constantly varying, in like manner the quantity of blood alternately received into, and expelled from, the cavities of the heart—which are never quite empty—is constantly changing. "If," says Hunter, "we suppose that the left ventricle could hold four ounces of blood, it usually contains only three ounces, and will only contract sufficiently to expel *two* ounces." This calculation must, however, be considered as having been made by that ingenious physiologist for the purpose merely of illustration, but it enables us to explain, in a satisfactory manner, many phenomena of the circulation. In disturbances of the circulation, numerous changes also take place in the quantity of blood contained in the cavities of the heart; there is always found after death a larger quantity of blood in the right than in the left heart.

John Hunter.

The Two Hearts.

The difference of the two hearts.

The apparatus of the two hearts, the "right and left," or the "pulmonic" and "systemic" heart, materially differ, the one being subservient to the "greater," and the other to the "lesser" circulation, and notwithstanding their juxtaposition, yet they are completely separated, being associated only through the medium of the capillary system. This separation of the two hearts is, indeed, so remarkable in some *cetaceous* animals, that each appears to be a distinct organ.

Their difference in diseases.

It is the differences in the structure, and in the functions of the right and left heart which enables us to explain many important phenomena in the thoracic circulation, as well as in the diseases of the heart,—the *right* heart being intimately associated with diseases of the *venous*, and the *left* heart with diseases of the *arterial* system. The difference, therefore, in the structure and in the functions of the two hearts is important to consider; as the common notion, that the one performs only the "greater," and the other the "lesser" circulation, leads to erroneous conjectures about the proper offices of each.

The Two Bloods.

In like manner, as there are two hearts, so are there two bloods—the *arterial* and the *venous*—the *systemic* and the *pulmonic*—the *red* and the *black*—materially differing from one another in their qualities, as well as in their quantities.

Differences in the arterial and venous blood.

Ingredients.

The arteries convey the vital fluid, properly eliminated, throughout the system, whilst the veins return it to the heart after the ingredients have been separated from it, which are necessary for the life and growth of the body, and also those, the retention of which are unnecessary or hurtful.

Momentum of the arterial and venous blood.

Hence the great difference in the composition of the blood, both when it leaves the heart, and when it is returned to the heart: notwithstanding these important differences in the two bloods, much ambiguity and confusion has crept into both physiological and pathological writings, from the term "blood" being used in a generic sense, disregarding the specific difference between the arterial and the venous blood.

Differences in the quantities, in the proportions, and in the qualities of both the bloods have a great influence on the action of the heart.

The blood differs in quantity;

In *quantity* the blood varies much in different individuals. This variety is remarkable in fat persons, and in those who spend their life in sloth, compared with those who undergo great bodily fatigue.

The quantity of the blood also varies at the different periods of life, and in the same organ at different times.

and in the proportion of

Not only does the quantity of the whole mass of blood differ,

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the red and black blood.

but the *proportion* of blood in the arterial and venous systems is frequently changing, as well as the proportion of the two bloods in particular organs.[1]

Differences at different periods of life;

There is a difference in the relative proportion of the arterial and venous blood at different periods of life, the arterial blood in young persons being in a larger proportion than the venous blood; whereas, in those advanced in years, there is a larger proportion of blood in the veins than in the arteries.

(Cullen)

"This difference of the quantities of the blood in the *arteries* and *veins* manifestly occurs in the ordinary progress of life; but it is also probable that in some persons the same difference, to a certain degree, takes place through the whole course of life, and gives a constant and considerable difference in the temperaments of men."

and in diseases.

In *diseases*, the differences in the proportion of the arterial and venous blood are remarkable. In inflammatory affections of the cutaneous and mucous surfaces, the changes may be seen in the vascular system. In an acute stage of inflammation, the bright crimson colour of the inflamed parts points out, that the chief seat of the disease is in the arteries; whilst the purple hue —the character of a more passive, or chronic inflammation, shows that the greater proportion of blood is congested in the veins.

In those diseases where there is an excess of the mass of blood, it is most frequently accumulated in the arteries of the young, and in the veins of the aged. Hence the difference in the character of diseases at the different periods of life; and hence, too, an arterial and a venous *plethora*. These remarks strictly apply to the diseases of the right and left heart; for although both the arterial and venous systems may be conjointly affected, yet in some diseases, one of the hearts only has its functions disordered.

Differences in its qualities.

In its *qualities*, there are great differences in the blood of persons in health, the proportion of the red globules and of the fibrine vary. In different races of animals, the qualities of their blood differ also considerably; its component parts differ in fish, in birds, and in insects; and in some tribes it is red or pale, and in others warm or cold.

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[1] During life "the blood is shared in some proportion or other, between the arterial and venous systems; and however much the balance may vary at different times between these systems, still the blood is constantly passing from the one to the other, and must at all times be divided between them in such a way that neither of them can ever be perfectly depleted or congested at the expense of the other."—Kellie, *Ed. Med. and Chir. Trans.*

Important changes take place in the qualities, both of the arterial and venous blood in diseases; all which changes have more or less influence on the functions of the heart. Any imperfection in the pulmonary apparatus, which interrupts the due oxygenation of the blood, or which does not remove from it the excrementitious elements, will cause disturbance throughout the whole system. On the other hand, if the venous blood be returned to the heart, without having undergone the proper changes in the different organs, or if the chyle, which is added to it, is not of a healthy character, various disturbances are produced in the sanguiferous system.

The Two Circles of the Blood.

Not only are there two hearts and two bloods, but there are two separate and distinct *circles*, in which the whole mass of the blood flows.

The Greater and Lesser Circulation.

In the "greater circulation" the *red* blood is ejected from the heart, distributed throughout the body, and, after the elements necessary for life, and the excretions have been separated from it, it returns by the veins into the right heart.

In the "lesser circulation" the *black* blood, after leaving the right heart, and being oxygenated in the lungs, passes into the left heart.

Thus, in one circle, there is the red blood leaving the heart and the black blood returning to it; and, in the other circle, the black blood leaving the heart and the red blood passing into the heart.

The quantity of Blood which enters and leaves the Heart, is equal.

As the difference in the length of the two circles made by the blood must be very considerable, and as the same quantity of blood passes through each circle in the same length of time, the velocity of the two streams, the one entering and the other leaving the heart, would be proportionably different, were not means provided by the economy to equalize the velocity of the two currents; for it is quite evident, that, if that were not

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the case, and if the force which propels the blood were the same, and the canals in which it flows were of equal calibre in both circles, the circulation of the blood could not go on.

How this is effected.

To equalize the quantity of blood which enters, and that which leaves the heart, the muscular parietes of the right heart are much thinner than those of the left heart, whilst also the aggregate area of the pulmonary vessels is much greater than the area of the aorta.

Hence any difference in the velocity of the currents of the blood in the "greater" and "lesser" circulation, is compensated for, by the difference in the propulsive power of the two hearts, and by the difference in the area of the two systems of vessels through which the blood flows.

Further, though the velocity of the red blood, when it leaves the heart, and the velocity of the black blood, on returning to the heart, be uniform, yet in its transit through the body, the velocity of the *red* blood must undergo almost endless changes from *vital* causes, as well as from peculiarities in the form and arrangement of the vascular system in the various organs. So likewise must the velocity in the stream of the *black* blood be modified by the larger area of the pulmonary capillaries, when compared with that of the pulmonary artery and veins, and also, by the constant changes which respiration causes in the pulmonary circulation, by the alternate distention and collapse of the bronchi.

Thus, it appears that whatever changes take place in the circulation of the *red* blood in its transit through the arterial and capillary systems, and whatever be the difference in its velocity before it reaches the veins, it is to the venous system that we are to look for those means which adjust the velocity in the current of the *black* blood when it reaches the right heart. Such, indeed, is the power of dilatation in the veins,—the influence of the contraction of those muscles which are adjacent to them,—the mechanism of the right heart,—the powers of adjustment in the heart itself, and the structure of the respiratory organs, that, as shall be fully explained hereafter, the supply of blood in the heart is balanced in such a manner, that the quantity which is received into, and ejected from, the heart, shall always be the same.

The Two Audible Sounds.

Cause of the Sounds.

In its passage through the irregularly-formed cavities of the heart, the blood flows in a variety of currents, and these currents produce sounds, though only two of them are perceptible to a common ear.

Observation of Harvey.

"Every one may see, when a horse drinks," observes the immortal Harvey, "that the water is driven in and transmitted to the stomach at each movement of the throat, the motion being accompanied with *a sound*, and yielding a pulse, both to the ear and to the touch. In the same way it is with the heart, when there is a delivery of a quantity of blood from the veins to the arteries, that a pulse takes place and can be *heard* within the chest."

Illustrated in Aneurisms.

That the sounds of the heart are caused by the currents of the blood passing through its cavities, receives the most conclusive evidence by examining a common "aneurism;" the "whizzing noise" so characteristic of the aneurismal swelling, being caused by the stream of blood which passes from the arterial canal through the mouth of the aneurismal sac, and repasses from the aneurismal sac into the canal of the artery. A still more incontrovertible proof of the sounds being caused by the blood's currents, is afforded by examining a "varicose aneurism,"—a sound being produced by the current of the blood passing through the opening that has been made in the artery by a wound, and also by the current that passes through the corresponding opening in the vein. The sound produced by these two currents was described by William Hunter, who was the first who gave an account of the disease, "as if there was a blast of air passing through a small hole, like that which is produced in the mouth by continuing the sound of the letter R in a whisper."

Medical observations and inquiries.

Differences in the two sounds.

The two audible sounds vary in different persons, differing in intensity, and in duration. In some individuals, they are sharp and acute, in others they are more or less dull, or even scarcely audible. The first or "*systolic*" sound is usually flat, whilst the second or *diastolic* sound is sharper, clearer, and shorter than the first.

These two sounds follow each other in rapid succession, after which there is a short pause,—one of the sounds corresponding with the auricular, and the other with the ventricular contractions. "Both auricles are contracted while the ventricles are relaxed; and the contraction of the auricles precedes the contraction of the ventricles, as we are convinced from manifest experiments on dying and on cold-blooded animals." Haller.

How the sounds are changed.

Changes in the currents of the blood, it must, however, be borne in mind, are constantly taking place during health. The velocity in the efflux of the arterial blood, and in the influx of the venous blood, is always changing, and the great inequality of the surface of the heart's cavities, which execute the important office not only of giving special direction to the blood, but of mixing the two bloods, must contribute to render changes in the currents almost endless. Though it be admitted that all such changes must cause corresponding changes in the sounds, yet it is impossible that all these sounds can be sufficiently intense to be recognised by our sense of hearing. Hence it may be legitimately inferred, that every change in the form of the cavities of the heart from an alteration in the structure of their parietes, or of the valves of their communicating orifices, or of the parts surrounding them, that corresponding changes must take place in the currents of the blood, and consequently in the sounds.

Their number is endless.

Their use in diagnosis

Changes in the sounds, therefore, become diagnostic signs in the diseases of the heart; and when taken in conjunction with the physiological symptoms, they form a useful addition to semeiology. At the same time, it must not be supposed, that the numerous diseases of the tissues, and of portions of those tissues which enter into the composition of the heart, could produce such a series of audible changes in two sounds as could be recognised by the most acute ear, or that each of such changes in the sounds could point out any particular specific structural change. Still less could it be anticipated that the numerous changes in the blood's currents, which take place in the functional diseases of the heart, could produce a change in the characters of the sounds sufficiently intense to be distinguished by the human ear.

The Tilting of the Heart.

"The heart is erected and rises up to a point, so that at this time it strikes against the breast, and the pulse is felt externally." Harvey. The alternate contractions and relaxations of the muscular parietes of the heart, cause in it a very considerable movement, the apex being "tilted" upon the parietes of the chest.

To admit of this motion, there is a particular structure assigned; the mode by which the aorta and pulmonary artery are united to the ventricles forming a kind of hinge, which readily admits of the tilting.

"The walls of the aorta and pulmonary artery, from the upper edge of their embossments or sinuses, down to their origin in the tendinous brim of the ventricular foramen, turn gradually thinner, more limber, and less elastic than anywhere else." This thin and less elastic condition of the root of the aorta, and pulmonary artery, is a structure evidently intended to admit of the heart's movements, and by which the blood will flow more readily, and in a rectilineal direction, into the great arterial trunks. The opposite position of the apex of the heart, which takes place when the ventricles are replenished with blood, will favour the entrance of the venous and the pulmonic bloods into the auricles, in the same manner as the exit of the systemic blood is facilitated by the tilting of the apex. The thin coats of the veins are equally calculated to permit them to assume a more rectilinear form, when the attitude of the heart is thus changed.

Jeffrey's Observations on the Heart.

It is chiefly this tilting of the heart which gives the shock to the walls of the chest,—more technically called the *impulse*, so evident to the sense of touch; but varying in its intensity from peculiarities in the natural form, or in the thickness of the walls of the chest, from differences in the bulk of the heart, from differences in the vigour of the circulation, and likewise from different positions of the body.

The impulse caused by the tilting.

As the *impulse* is a measure of the intensity of the blow given to the parietes of the thorax by the tilting of the heart's apex, and as the blow of the apex is a measure of the strength of the ventricular contractions, the impulse of the heart has always been deemed a test of the vigour of the circulation.

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Changes in the position of the heart.

Loosely suspended by the great arterial and venous trunks in the cavity of the pericardium, the heart likewise admits of considerable changes in its *position*, from changes in the position or in the form of the adjacent viscera.

"The heart rolls about in the thorax. We turn to our left side in bed, and it beats there; we turn over to our right side, and the heart falls back into the chest, so that its pulse is nowhere to be perceived; we incline to our left side again, and it beats quickly and strongly. The heart is raised by a full stomach, and is pushed upwards in dropsy; and during pregnancy its posture is remarkably changed: it is suddenly depressed again when the child is delivered, or the waters of a dropsy are drawn off. It is shaken by coughing, laughing, and sneezing; and, by matter collected within the thorax, the heart may be displaced to any degree."

John Bell's Anatomy.

The Fibro-elastic Tissue.

In the composition of the heart, there is a considerable quantity of the *yellow fibro-cartilaginous* tissue, similar to the fibrous coat of the arteries. This structure commences at the root of the aorta, and pulmonary artery by three festoons, where they emerge from the heart's cavities. By the elasticity of this tissue, it assists these cavities alternately to expand and contract, and thus to accommodate themselves to the constant changes in the quantity of blood which is propelled into them.

The *chordæ tendineæ*.

The *chordæ tendineæ* also form a distinct ingredient in the heart's composition, assisting in mixing the blood, and in giving, by their action on the valves, special directions to the different currents. Some of these cords are so placed as to serve the purpose of preventing the cavities of the heart from being over-distended.

The Pericardium.

The heart is covered externally by a capsule, or *pericardium*, and its cavities are lined by the *endocardium*: both which membranes, though they are in some respects analogous, must not be strictly compared to each other, either in their structure, in their functions, or in their pathological conditions.

Its structure.

The pericardium, according to Bichat, "is composed of two distinct structures; and, although they are found in a great measure united and identified, the general disposition of both is so different, their nature, their properties, their uses distinguishing them so remarkably, that it is absolutely impossible to describe them together, and to consider the pericardium as a single organ when we examine its anatomical details. Of these structures the exterior is *fibrous*, and the interior is *serous*."

Traité sur les Membranes.

Its different offices.

The offices which the *pericardium* performs are twofold. It affords a smooth and moistened surface, not unlike that of a *bursa*, in order to facilitate the constant motions of the heart upon the adjacent parts. Being a very dense and strong membranous bag, by its connexions with the mediastinum and the diaphragm, it suspends the heart, and prevents its being displaced during its unceasing movements, or *tilting*, or by changes in the form and position of the adjacent viscera.

In a therapeutical, as well as in a pathological point of view, it is important to observe, that the pericardium is not supplied with blood from the coronary arteries, but by branches which come direct from the aorta,—from the internal thoracic,—and from the superior diaphragmatic arteries.

Its structure in some animals.

There is likewise a remarkable difference in the structure of the pericardium in some animals, a difference which must serve to modify its office. In the *hedgehog* it is so extremely thin, that its existence has been disputed by some anatomists, and in the *lamprey* it is cartilaginous.

Its changes in disease.

In its diseases the interior surface of the pericardium has a strict analogy to that of other *serous* membranes, as the pleura, peritoneum, and membranes of the brain. By an attack of inflammation, its surface is covered with coagulable lymph, the fluid which its surface exhales is increased in quantity, and the membrane itself is increased in thickness.

The adipose matter.

There is always upon the exterior of the pericardium a quantity of *adipose* substance, the uses of which have never been satisfactorily explained. All we know is, that fatty matter is usually met with in the largest quantity upon the hearts of thin people; and it is found in a large quantity upon the heart of the *sturgeon;* but there is none of it on the hearts of wild animals which are exposed to great muscular exertion.

The Endocardium.

Though the membrane which lines the heart and arteries bears a certain analogy to, and has been classed by the ingenious Bichat amongst the *serous* membranes, yet there are peculiarities in its structure and in its functions, as well as in its pathological conditions, which are not found in the other membranes of the same class; it ought, therefore, not to be considered simply as a serous membrane, but as a tissue *sui generis.*

The endocardium is extremely thin, has no visible fibres, is somewhat brittle, and is easily torn, especially where it is continued into the arteries.

Bichat. Traité sur les Membranes.

The surface of the endocardium is remarkable for its smoothness and polish, and is covered with an unctuous fluid, so that the blood flows over it with great facility.

Its changes in diseases.

The most remarkable feature, in which this membrane differs from all other serous membranes, is in its diseases. The bright, scarlet-coloured patches, or *stains* that are so frequently found upon it, cannot be traced either to an increased vascularity, as no distinct vessels can be detected in them, or to *imbibition*, for they cannot be imitated by macerating an artery in blood.

There is also to be observed a striking difference in the quantity of lymph effused upon the interior and exterior membranes of the heart, when these tissues have been inflamed. We seldom or never find those large masses of coagulated lymph in the cavities of the heart, or upon the interior surface of the aorta, so constantly met with in *pericarditis;* and, although there may be an exudation of coagulable lymph from the inflamed *endocardium*, yet it is probable that more or less of it will be washed away by the stream of blood which is constantly passing over it.[1]

The Valves of the Heart.

The valves perform the essential office of regulating the transit of the blood through the different compartments of the heart.

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[1] It has been lately pointed out by Dr. Kirkes, that sometimes a portion of lymph passes into one of the cerebral arteries and obstructs it; by which the functions of that portion of the brain, supplied by the artery, cease.

Office of the valves.

These floodgates not only direct the vital stream into its proper channels, but they prevent any congestion of blood within the heart, which would otherwise be constantly taking place from the impediments to the circulation, which are created by the increasing changes in the circulation of the various organs, and also by the movements and different attitudes of the body.

When the structure and form of the valves become diseased, the changes which are produced in the currents of the blood, within the heart, materially influence the whole sanguiferous system. Having therefore become acquainted with the offices which each of the valves performs in the healthy state of the body, we are then prepared to investigate the changes which the circulation undergoes when they become diseased.

The Valves of the Right Heart.

The Eustachian valve;

For directing the vital stream into the right auricle, the *Eustachian valve* is so placed, that the venous blood, flowing from both the upper and lower cavæ veins, must pass into the right auricle, and, along with the blood from the coronary veins, the whole mass then passes into the right ventricle.

The compartments of the right heart are constructed in such a manner, as not only to receive the two great and opposite currents of the blood from the cavæ veins, but from the irregularity of their surface, and their contractile powers, all the venous blood is intimately mixed, and from the chyle being at the same time added to it, a process of churning takes place, by which the whole of the vital fluid is rendered homogeneous before it is ejected into the lungs.

its varieties; its form in animals,

The Eustachian valve varies exceedingly in its size in different adults. In the lower animals, there are many varieties in the form of this valve, to enable it the more perfectly to perform its functions, whenever, from the position of the body, the proper direction of the venous currents would be liable to interruptions. In lions, dogs, and bears, this valve is altogether wanting.

The *tricuspid valve* differs in its office from all the other valves of the heart, not only directing the current of the venous blood, as it passes from the right auricle into the right ventricle;

Chap. I.

Peculiarity of its structure.

but such is the construction of this valve, that it may either completely close the auriculo-ventricular opening, so as to direct all the blood which the ventricle contains into the pulmonary artery, or if the ventricular cavity be distended beyond a certain limit, the aperture of the valve may then be widened; thus any superabundant blood in the ventricle is permitted to repass into the auricle, and from thence into the ventricle.

This peculiarity in the mechanism of the *tricuspid* valve (*bb*) was remarked by Hunter. "I believe the valves of the right side of the heart are not so perfect as those of the left;" and again, "I have reason to believe that the valves on the right side of the heart do not so perfectly do their duty as those of the left; therefore we may suppose it was not so necessary." But the precise use of this structure was left for King to explain, and he was led, from its functions, to consider it, and give it the appellation of a *safety*-valve.[1]

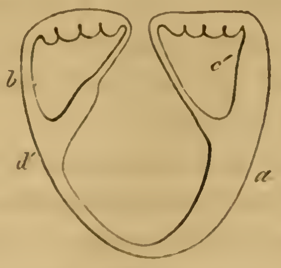

Fig. 1.

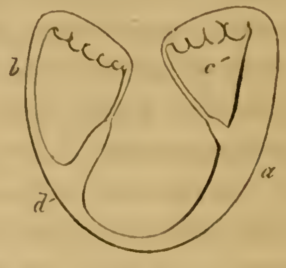

Fig. 2.

The venous blood being thus permitted to regurgitate from the right ventricle into the right auricle, its reflux will also take place from the right auricle into the cavæ veins; afterwards it will accumulate, and stagnate throughout the venous system, in a greater or less quantity, according to the degree of obstruction there may be to the circulation.

Office of the Tricuspid valve.

By this mechanism, the tricuspid valve is enabled to perform a most important office in the pulmonary circulation, preventing any congestion of the blood in the pulmonary arteries—a circumstance which would be constantly taking place in a more or less degree, from every change in the quantity of air contained in the bronchi, if the superabundant venous blood could not regurgitate into the right auricle, and from thence pass into the venous system.

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[1] The mechanism of the tricuspid valve may be more fully understood by a reference to the accompanying diagrams, selected from King's interesting memoir, published in Guy's Hospital Reports. In both figures (*a*) represents the solid wall of the left ventricle, (*b*) the yielding wall of the right ventricle, (*c*) the fixed curtain with its cord. Fig. 1 shows the valve when closing, and Fig. 2, the yielding wall distended.

In Birds.

In *birds*, the Eustachian valve is a strong, tense, nearly triangular-shaped muscle. Blumenbach considered "that this singular structure assists in driving the blood, with greater force, from the right side of the heart into the lungs, since the expansion of the lungs in respiration, which facilitates the transmission of the oxygenated blood in the mammalia, does not take place in birds, on account of the connexion which their lungs have with the numerous air-cells."

Comparative Anatomy.

The semilunar valves of the *pulmonary artery* are so formed by the folds of the inner membrane, that, when they are closed, they prevent the regurgitation of any blood from the pulmonary artery into the right ventricle; but that a certain quantity may repass is not impossible, if we can venture to draw any inference from experiments made on the dead body. "The valves of the pulmonary artery," observes Hunter, "do not do their duty so completely as those of the aorta, and they want the *corpora sessamoidea.* If we inject the pulmonary artery towards the heart, it does not so completely hinder the wax passing into the right auricle. Nor are the two portions of injection completely separated, as in the left heart, when the artery is injected from the ventricle."

The Valves of the Left Heart.

The office of the compartments of the systemic or *left heart* materially differ from those of the right heart.

The Mitral valve.

The *mitral valve*—the floodgate, which is placed between the left auricle and the left ventricle, completely closes the auriculo-ventricular aperture, and thus prevents the regurgitation of any arterial blood from the ventricle into the auricle, so that none of the arterial blood can return into the pulmonary veins.[1]

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[1] *Structure of the auriculo-ventricular orifices.*—"I removed portions of the semilunar valves of both the pulmonary arteries and the aorta. I cut away large portions of

Difference in the office of the two auriculo-ventricular valves.

The auriculo-ventricular valves of the two hearts have, therefore, to perform very different offices: in the *left* heart the mitral valve forming a complete barrier to the regurgitation of any arterial blood from the left ventricle into the left auricle, and in the *right* heart, the tricuspid valve yielding by any over-distention of the right ventricle, and permitting the venous blood to regurgitate into the right auricle, and thence into the *cavæ* veins.

The Aortic Valves.

The *semilunar* or sigmoid valves of the aorta are admirably constructed for performing the important office to which they are assigned. When closed, they completely prevent the regurgitating stream of the aortic blood from passing into the left ventricle.[1]

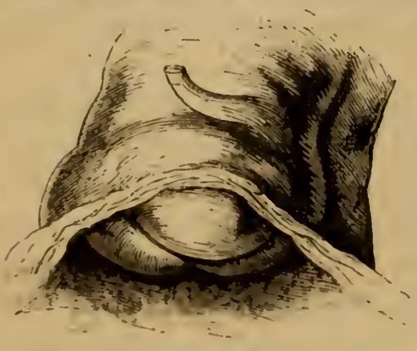

Fig. 3.

Hunter.

"By injecting against them, in proportion as the artery is distended, the valves *recede* from the sides of the vessel, and, if the artery is fully distended, the communication is entirely cut off between the two pieces of the injection,—that within the ventricle and that within the artery."

That aortic blood regurgitates during the diastole of the heart,

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the auricles to expose their communication with the ventricles. On injecting the *left ventricle* from the aorta, the *mitral valve* at once became forcibly closed, presenting the appearance of a continued suture. The pressure of the syringe and distention of the ventricle being maintained, no injection escaped. Great force was necessary to disarrange this state, and produce a narrow thready jet of injection, on injecting the pulmonary artery."—*Hunter.*

[1] "The internal membrane of the left heart, after having lined the ventricle, is continued to the mouth of the aorta, separates from it, and forms by its folds the three *semilunar valves;* it is afterwards continued along the artery through its whole course. This internal membrane is the only bond of union between the artery and the heart. The proper or fibrous membrane of the artery is not intermingled with the muscular fibres of the heart, but the extremity of the artery is cut out into *three semi-circular festoons*, each festoon corresponding with one of the sigmoid valves. These festoons do not extend quite so far as the fleshy fibres of the ventricle; there is between them an interval of two or three lines, which is closed only by the internal membrane. Between each festoon, and consequently between the valves, we perceive three small triangular empty spaces, which are also covered with the membrane. To distinguish this structure it is necessary to dissect accurately the origin of the aorta from without, and to remove the adipose tissue which surrounds it."—Bichat, *Anatomie Générale.*

The Regurgitation of the aortic blood.

the position of the semilunar valves affords a striking proof; these floodgates being so placed, as to prevent any of the regurgitating stream from entering into the left ventricle,—an apparatus which, it is evident, would not be required, if there were no regurgitation of the aortic blood.

The force with which the blood in the aorta regurgitates must be very considerable, judging from the means employed to prevent any of it from re-entering the left ventricle. Thus, when some of the voluntary muscles contract, such as those of the extremities, they must compress the *arteries* as well as the veins which are adjacent to them; the impetus, in the stream of the aortic blood, being thus impeded, it will then regurgitate, and the force of the regurgitating current will be according to the duration of the muscular contractions.

Supernumerary aortic valves in some animals.

It sometimes happens, however, though rarely, that the semilunar valves are torn by the aortic blood being driven back with a force which they are unable to resist; to prevent this, in some aquatic and amphibious animals, the aorta is provided with *supernumerary valves*. The animals in which supernumerary aortic valves have been found live under circumstances, and have habits, which expose the heart to a powerful regurgitating current of blood, so that the supernumerary valves in the aorta prevent the regurgitating stream from overcoming the resistance which is made by the semilunar valves, and re-entering the left ventricle.

In the Frog.
An. 1761.

This remarkable structure, of the aortic valves, was first described in the *frog*, by Duverney; and it appears probable that the four rows of supernumerary valves are necessary to protect the semilunar valves from giving way,—thus preventing the regurgitating aortic blood from re-entering the left ventricle, whenever the excessive muscular exertions, which these creatures make in the act of leaping, obstructs the reflux of the arterial blood from the heart.[1]

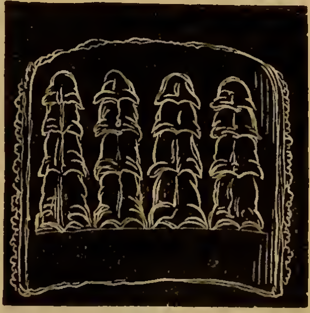

Fig. 4.

In the Whale and in other amphibia.

In the aorta of the *whale*, there are also supernumerary valves. In consequence of the enormous pressure to which these animals are exposed, besides the supernumerary valves in the aorta, to prevent the regurgitating blood from re-entering the left ventricle, there is also a very large vascular *plexus* in the thorax, for receiving the blood which is driven from the exterior of the body when the animal plunges into deep water. So deep do they sometimes descend, that the weight of the superincumbent water has been calculated to exceed that of the atmosphere no less than fifty times, a depth equal to two or even three thousand feet below the surface of the ocean.

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[1] Fig. 4. A magnified view of the aorta laid open in a frog, showing *four* lines of valves with their *tubercles*, the last being much larger than the first.

Teideman. Museum of the College of Surgeons. Fig 5.

In order to perform a like function, in the *sturgeon* there are three rows of aortic valves, and in the aorta of the *shark* there is a double row of valves.

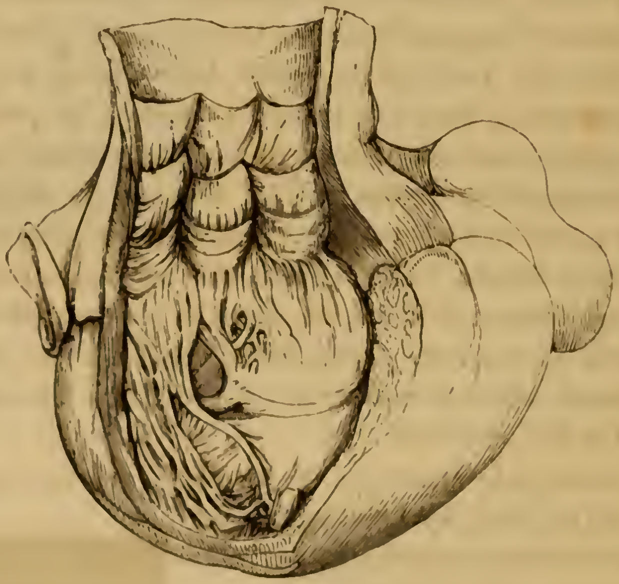

Fig. 5.

Aorta in some animals have bones.

Whilst supernumerary aortic valves are employed in some animals, to prevent the evil effects of the regurgitating aortic blood, in other tribes, such as the *ox*, the *sheep*, the *deer*, and the *pig*, the root of the aorta is provided with scales of *bone*, by means of which the regurgitating stream of blood, propelled by any violent action of the left ventricle, cannot injure the coats of the aorta.

Comparative difference of the two hearts

From what has been now said of the valvular apparatus in each of the two hearts, it is apparent how different are the offices which each heart has to perform in the circulation.

The heart and lungs guarded against congestion.

The structure of the *right heart* is such that, whilst it impels the venous blood from the right ventricle into the lungs, yet as the valve of the auriculo-ventricular aperture is capable of being *widened*, venous blood can regurgitate into the right auricle, and thus prevent any congestion of the venous blood in the lungs.

By means equally simple, nature has contrived to ward off any pulmonary congestion of the arterial blood; as both the mitral and semilunar valves completely prevent any of the regurgitating aortic blood repassing into the left auricle and pulmonary veins.

How the lungs become congested.

Thus the lungs are secured from congestion either of the venous or of the arterial blood, to which they would be constantly exposed, had no such provision been made,—changes in respiration increasing or diminishing the size of the bronchi, and consequently altering the quantity of blood in the pulmonary vessels, and the return of the venous blood to the right heart is accelerated, whilst the stream of the arterial blood from the left heart is impeded by the movements of the voluntary muscles.

Hereafter I will endeavour to explain how, in like manner, the injurious effects from those temporary disturbances in the circulation, which are almost constantly taking place during wakefulness, are guarded against; and likewise, how, when disturbances in the heart proceed beyond certain limits, the instinctive acts of sobbing, sighing, crying, weeping, and vomiting, are resorted to by the economy for restoring the proper balance of the circulation. But whenever it happens, that a disturbance in the circulation, caused by an increase of the blood within the heart, becomes such as cannot be relieved by those means possessed by the economy, or, to use the language of the schools, when the powers of the *vis conservatrix naturæ* are insufficient for that purpose, the heart may then be properly said to be in a state of *congestion*.

The Coronary Arteries and Veins.

The Nutrient arteries of the heart.

The coronary arteries constitute an essential portion of the heart's structure. Besides the two circles made by the whole mass of blood, in "the greater and the lesser circulation," there is a third circle which is made by the blood in the coronary vessels.

Their peculiarities.

The coronary arteries of the heart are not only of larger dimensions than other arteries, in proportion to the bulk of the organ which they supply, but there are peculiarities, both in their *origin*, in their *course*, and in their *distribution;* all which are essential to be kept in view, in our pathological inquiries on the central organ of the circulation.

Their origin.

The coronary arteries arise from the root of the aorta, at an obtuse angle, on the *distal* side of the semilunar valves. Behind each of these valves there are the " lesser sinuses," pouches or dilatations of the arterial canal, at the upper part of which the coronary arteries arise ; and as the semilunar valves always float in the vital stream, the current of the blood ejected from the left ventricle not being able to press the valves against the sides of the aorta, the regurgitating stream of the aortic blood can readily flow into the coronary vessels.[1]

See fig. 3.

Thus is secured a constant current of blood into the coronary arteries—a stream flowing into them, both during the systole and the diastole of the heart—which could not take place did these arteries arise from the aorta on the *ventricular* side of the valves : if we could suppose that there was not such a structure, it would be then impossible for any of the retrograde stream of the aortic blood to flow into the coronary arteries during the closure of the semilunar valves.

Here we have another proof of the simplicity in the means which the economy employs, and how *two* most important functions are executed at the same time by the same physical apparatus,—the means which are resorted to in order to increase the blood in the *cavities* of the heart, being also those which increase the influx of the vital element into the coronary arteries ; and thus when the heart is required to propel an additional quantity of blood, its muscular structure is, at the same moment, provided with an additional supply of blood, and it is thus enabled to act with increased vigour.

Although this is the usual origin of the coronary arteries, yet some deviations have been found both in their origin and number.

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[1] " The orifices of the *coronary arteries* will always appear above the *edges*, when the valves are placed against the inner surface of the artery, whilst it continues in its cylindrical shape ; but when the artery is slit open and flattened, the edges of the valves will appear to cover the openings of the coronaries, and I presume, has deceived those anatomists who have stated that the valves must be placed *before* the blood can enter the coronary arteries."—Wilson's *Lectures on the Vascular System.*

In some animals.

The coronary arteries present some varieties in their origin in the inferior animals. "In *quadrupeds* and *birds* they arise, two in number, from the aorta, just at its beginning behind two of the semilunar valves. In the *amphibia* they arise at some distance, and not always from the aorta, in the same species often from the subclavian artery, and often from the anterior surface of the ascending aorta. In the *fish* they arise from the arteries as they are coming from the gills." Hunter.

Their course.

In their *course*, the coronary arteries exhibit a great peculiarity, described by Professor Jeffrey, to which I shall afterwards refer, when pointing out the influence of muscular contractions upon the circulation in arteries. The coronary vessels, in place of being encircled by, or intermingled with the muscles, pass along the tendinous and deep grooves which separate the auricles from the ventricles; by which simple contrivance neither the arteries nor the accompanying veins can suffer any compression to interrupt their circulation, either from the auricular or ventricular contractions.

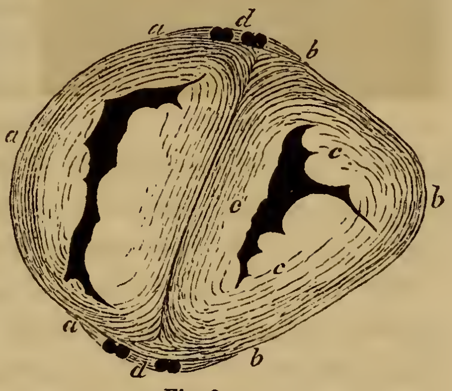

Fig. 6.

By making a vertical section of the heart, the relative position of the coronary vessels and muscles of the ventricles is seen, and it is evident that neither the contraction nor relaxation of the muscles can have any influence on the transit of the blood. Fig. VI. (*a*, *a*, *a*) the muscular parietes of the right, and (*b*, *b*, *b*) the parietes of the left ventricle; (*c*, *c*) and (*d*, *d*) are the mouths of the right and left coronary arteries and veins.

" But, though the trunks of the coronary arteries and veins be thus protected, their *branches*, in the substance of the ventricles and auricles, must suffer compression, when these are in contraction; and as the auricle is in diastole, when the ventricle is in systole, blood will pass up freely into the substance of the auricle, when the ventricle is in contraction, and as freely down into the ventricle, when the auricle is in contraction; so that although each of them receives blood, only during half the time of the heart's beat, the coronary trunks must be receiving blood constantly from the aorta; else they could not furnish a regular and alternate supply." Jeffrey.

Their anastomosis.

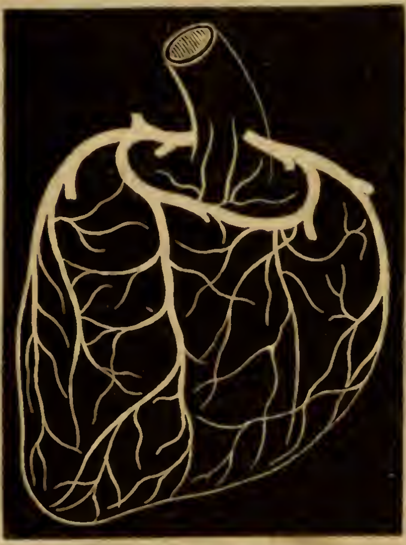

Fig. 7.

The coronary arteries *inosculate* very freely with each other, and the surface of the heart is covered with a prodigious number of minute branches. The chief inosculation of these two arteries is formed near the base of the heart, each trunk giving off a large branch, which inosculates with the other, thus forming a complete arterial circle round the heart. Whatever anastomoses there may be with the more minute ramifications of these vessels, it is evident that the relation, established between the two arteries, is chiefly effected by the ring of anastomoses; and this ring is so placed that the muscular contractions of the heart's parietes cannot interrupt the free circulation.

Their termination.

The two coronary arteries supply with blood, not only the muscular tissue of both auricles and ventricles, and the coats of those portions of the large arterial trunks which are within the pericardium, but some of their branches are also reflected on the pericardium itself. These branches inosculate with branches of the internal mammary, and bronchial arteries; thus establishing a vascular connexion, not only with the different structures of the heart, but with the parts adjacent: a connexion which is exemplified in many diseases.

Peculiarities of the coronary vessels.

The coronary vessels, both arteries and veins, constitute a circulation which is not analogous to that of any other organ. The origin of the arteries at the commencement of the aorta, their orifices being so placed, and of such a form, as to receive the retrograde, as well as the refluent stream of the aortic blood; their course being such that the flow of blood in them can never be interrupted by the contractions of the muscular parietes of the heart; and the direct termination of the coronary veins in the right auricle and ventricle, are all peculiarities in these vessels which execute an essential function in the circulation, and have a great influence in the heart's diseases.

Hereafter I will endeavour to explain by what means the economy regulates the quantity of blood within the heart, and how it is relieved of any undue quantity of blood by modifications in breathing. These processes, however, although they relieve the cavities of the heart, do not appear calculated to diminish the blood in the congested coronary vessels. To effect which purpose the peculiar arrangement of some branches of the coronary arteries terminate in the left side of the heart; and the ingenious observations of Abernethy appear to me to throw light on this interesting subject; a vascular distribution, which has often been disputed by eminent anatomists.[1]

The Foramina of Thebesius.

"There is a remarkable contrivance," he observes, "in the blood-vessels which supply the heart, not to be met with in any other part of the body, and which is of great use in the healthy functions of that organ, but which is particularly serviceable in preventing derangement of a part so essential to life."

Observations of Abernethy

A distended state of the blood-vessels must always impede their functions, and consequently be very detrimental to the health of the parts which they supply; but as the cavities of the heart are naturally receptacles of blood, a singular opportunity is afforded to its nutrient vessels to relieve themselves when surcharged by pouring a part of their contents into those cavities. Such appears to be the use of the *foramina*, by which injections, thrown into the blood-vessels of the heart, escape into the cavities of that organ, and which were first noticed by Vieussen, but being more expressly described by Thebesius, generally bear the name of the latter author.

Anatomists appear to have been much perplexed concerning these *Foramina Thebesii;* even Haller, Senac, and Zinn, were sometimes unable to discover them; which suggested an idea, that when an injection was infused into the cavities of the heart the vessels were torn, and that it did not escape through natural openings. When these *foramina* were injected, they were found under various circumstances as to their size and situation; and

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[1] "Observations on the *Foramina Thebesii* of the Heart," by John Abernethy. Philosophical Transactions, 1798.

Haller observed that the injection, for the most part, escaped into the right cavities of the heart. It also remains unexamined whether these *foramina* belong both to the arteries and veins, or respectively to each set of vessels.

It is from an examination of these openings in deceased subjects that a solution of such difficulties may probably be obtained. Whoever reflects on the circumstances under which the principal coronary vein terminates in the right auricle of the heart, will perceive that an impediment to the flow of blood through that vessel must occasionally take place; but the difficulty will be much increased when the right side of the heart is more than ordinarily distended, in consequence of obstruction to the pulmonary circulation. Indeed, it seems probable that such obstruction, by occasioning a distended state of the right side of the heart, and thus impeding the circulation of the nutrient vessels of that organ, would as necessarily occasion corresponding disease of it, as an obstruction to the circulation in the liver occasions disease in the other abdominal viscera, were it not for some preventing circumstances; which I now proceed to explain.

Having been attentive to some very bad cases of pulmonary consumption from a desire to witness the effects of breathing medicated air in that complaint, I was led to a more particular examination of the hearts of those patients who died. In these cases I found that by throwing common coarse waxen injection into the arteries and veins of the heart, it readily flowed into the cavities of that organ; and that the left ventricle was injected in the first place, and most completely. When the ventricle was opened, and the effused injection removed, the *Foramina Thebesii* appeared both numerous, large, and distended, with the different coloured wax which had been impelled into the coronary arteries and veins. Upon eight comparative trials, made by injecting the vessels of hearts taken from subjects whose lungs were either much diseased, or in a perfectly sound state, I found that in the former, common injection readily flowed in the manner which I have described into all the cavities of the heart, but principally into the left ventricle, whilst in many of the latter I could not impel the least quantity of such injection into that cavity.[1]

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[1] In the Catalogue of the Museum of St. Bartholomew's Hospital, mention is made of a preparation of an ox's heart, in which one of the Foramina Thebesius opens into one of the *Columnæ Carneæ!*

The Pulse of the coronary arteries.

No *stethoscopic* observer has recognised the sounds of the coronary arteries, though it is well known that they pulsate like other arteries. "Experiments made upon the arteries, and even upon very small vessels, as the mammary arteries, have satisfied me that they all beat at the same time, as also the *coronary artery;* although eminent men have told us that this little artery is different from the others in this respect, but having opened it at different times, I always found that it spurts at the time of the heart's contraction, and that the blood runs slowly at the time of its relaxation."

Haller's Dissertation on the motion of the blood.

All these peculiarities in the anatomy of the coronary arteries merit a careful consideration, when investigating the diseases of the heart; more especially those ailments which have been entirely overlooked by pathological writers,—diseases to which I shall particularly refer, when considering the influence of the action of the muscles, on the circulation.

When, therefore, it is considered, that of the numerous pathological conditions of the coronary arteries, no attempt has ever been made to recognise them by physical signs, whatever these signs may be, it is evident that they must have been confounded with, and attributed to, diseases of other parts of the heart.

The coronary veins.

Having shown the contrivances by which the coronary arteries provide the tissues of the heart with a constant supply of blood, we are next led to inquire, by what mechanism the *coronary veins* carry on the venous circulation.

The coronary veins, in a similar manner to the coronary arteries, are protected along their course from any influence of the contractions of the muscular parietes of the heart, and their termination in the right auricle is one of the striking peculiarities in the coronary circulation.

Although there may be a regurgitation of the venous blood into the two cavæ veins, caused by the contractions of the right auricle, any reflux of the venous blood into the great coronary vein is completely guarded against; that vessel having a semilunar valve placed at its mouth. By this mechanism, no venous blood can pass from the auricle into the coronary vein during the auricular contractions; and, at the same time, a provision is made by the *sinus venosus* for receiving whatever blood may

The sinus venosus—use of.

flow into the great venous trunk during the closure of its mouth. This sinus, or enlargement of the coronary vein, seems to be intended to perform the office of a *receptaculum*. It is so placed, in relation to the ventricle and auricle, that their systole and diastole cannot influence its circulation, and it receives the blood coming from all the venous branches into the trunk, until its mouth is again opened by the auricular diastole;—thus, any over-distention of the veins in the substance of the heart is carefully guarded against—a circumstance which would inevitably take place, were there no sinus.

"In general, throughout the system, it may be observed, that the blood in the veins flows in an opposite direction to that in the arteries, so that the two streams of blood are, as it were, opposed to each other. But, the current of the blood in the large branches of the *coronary veins*, which are placed alongside the coronary arteries, runs in the same direction with the blood in the arteries."

Jeffrey's Observations on the Heart.

From the arrangement of the coronary vessels it may be readily understood how disturbances in their functions may be materially affected, when the cavities of the heart become congested, or, when morbid changes are going on in any of its different structures—a circumstance which has hitherto excited but little attention from pathological inquirers.

The Muscles of the Heart.

Destined to propel the blood, not only through the lungs, but throughout the whole body, the muscles form an essential element in the composition of the heart.

The fibres of the muscles.

Though these muscles have the general characters of the voluntary muscles, yet their *fibres* are smaller, shorter, and more compact. They have scarcely any cellular tissue interposed between them; they freely anastomose, crossing each other in various directions, forming a complete muscular network.

From the direction of their fibres, these muscles, when they contract, greatly diminish the diameter of the cavities which they encircle, and they have no antagonist fibres to act in an opposite direction, like the muscles of the other organs of organic life. "The substances which are contained in the cavities to which they belong are the antagonists of the muscles of the heart." The fibres are arranged in "bundles," the bundles are enclosed in a delicate capsule, and are formed into *laminæ*. The left ventricle is composed of six, the right ventricle of three laminæ; and the left auricle has more laminæ than the right auricle. Thus, the muscular power of the two ventricles, and of the two auricles, is suited to the office in the circulation which is assigned to each.

Bichat.

Their laminæ.

"All the fibres of the muscles of the heart, whatever be their length, position, or direction," observes Gerdy, "form *nooses*, the convexities of which point towards the apex of the heart, and are more or less superficial at one of their extremities than at the other." This peculiar arrangement of the muscular fibres of the heart contributes, it is not improbable, to the power of the heart in circulating the blood; in like manner as particular arrangements have been contrived in the links of chains to give them additional strength.

See fig. 8.

Gerdy.

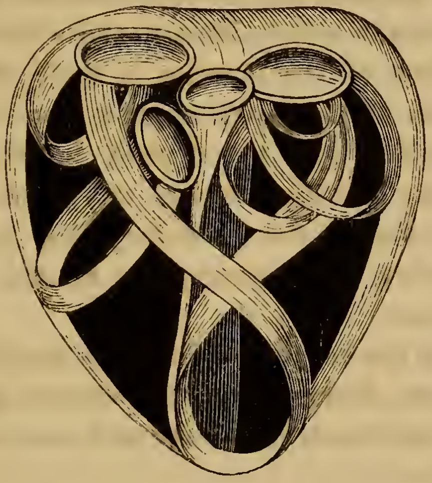

Fig. 8.

The *number* of the muscular fibres increase in proportion to the vigour of the heart's action; and in diseases the parietes often acquire great thickness. This is remarkable in *aneurisms*, where the thickness of the aneurismal sac may be considered as an effort of the "*vis medicatrix*," to enable the sac to withstand the force of the currents of the blood. A similar effort of the economy is observed in the *uterus*, when, during pregnancy, its muscular fibres are greatly increased, in order to assist, at the

Increase of the fibres.

time of parturition, the expulsion of the child. And when the urethra becomes contracted, an increase takes place in the muscular tissue of the bladder, more force being then required to expel the urine.

As the muscles of the heart increase in size, they likewise increase in *density*, becoming in the aged so tough and coriaceous, that they can only contract slowly and are easily fatigued. Bichat.

Their blood-vessels. The muscles of the heart are more abundantly supplied with *blood-vessels* than any of the other organs of organic life—a larger supply of the vital fluid being required to enable them to perform their unceasing action.

Their colour. In *colour* the muscles of the heart vary at the different times of life, being of a pale red in childhood, becoming more and more of a deeper red, until about the twentieth year, after which period they gradually become paler. The intensity of red colour also varies, according to the vigour and strength of the muscles; and it is never precisely the same in two subjects. "In general, those who die of dropsies and chronic diseases have the muscles very pale; whereas in acute diseases, and where death has been sudden, the colour of the muscles is little changed. In the aged, the muscles of the heart acquire a yellowish and fatty appearance; but this does not depend on fat, but arises from the absence of the colouring matter of the blood." Bichat. All these varieties in the colour of the muscular tissue are essential to be kept in view, when investigating the morbid changes in the muscles of the heart.

Their nerves. The muscles of the heart are plentifully supplied with *nerves;* numerous filaments, derived from the cardiac plexus, penetrate the substance of the heart, inosculate with one another, and have numerous *ganglia*. Remack.

Their actions are unceasing. There is an essential difference in the *function* of the muscles of the heart, from that of all other organs, except those of respiration—they have no repose, their unceasing action being absolutely necessary for the continuation of life. "How is it," says the illustrious Haller, "that the heart, with its incessant motion during so many years as there are in a lifetime, during so many days as there are in a year, and when in each hour it contracts not much less than five thousand times, never resting, but contraction perpetually succeeding repletion,—how is it that the heart is neither fatigued nor pained by so excessive an action,—an action which no other muscle could endure even for a few hours?"

Haller.

Their rythmic action.

Another remarkable feature in the functions of the muscles of the heart is, that they contract the cavities of the two hearts in a regular order; the two auricles and the two ventricles contracting and dilating alternately: this *rythmic action* continues, not only after the heart has been removed from a living animal, but even when it has been cut in halves; one-half comprising the two auricles, and the other the two ventricles; the rythmic action continues in the auricles, but ceases in the ventricles, so that the rythmic action appertains alone to the auricles.

Volkman.

This power of the heart, which was called by Galen "pulsive," is a power with which no other organs, except those of respiration, are endowed;—it resides in the heart itself, and can only be explained by admitting that the heart is provided with a separate and *special nervous system.*

The compound action of the heart.

The action of the heart may therefore be said to be *compound*, and to consist of two distinct movements—movements which are combined together in order to execute one great function.

The first movement.

In the *first* movement, the auricle and ventricle of each heart act separately—each auricle propelling its contents into its corresponding ventricle, and each ventricle propelling its contents into the arteries.

The second movement.

The *second* movement is common to both hearts, the two auricles and the two ventricles acting simultaneously.

Without this rythmic action of the two hearts, it is evident that the circulation could not go on; for however numerous may be the changes which take place in the currents of the blood, both in the "greater" and "lesser" circulation, it is quite certain, that the quantity of the black blood entering the heart, and of the red blood leaving it, must be always equal.

Their influence in diseases.

Though the circulation of the blood, in both its circles, be preserved uniform, yet, in diseases of the heart, either of its movements may be disturbed. The alternate action of the auricle and ventricle of one of the hearts may be changed, from alterations in the currents of the blood which passes through it; or the synchronous action of the two auricles and the two ventricles may be changed, when the nervous system of the heart, on which that movement depends, is disordered. The rythmic action may continue, but the pause between the auriculo-ventricular contractions may vary.

The peculiar character of their diseases.

To these functions of the muscles, may be attributed many remarkable features in the diseases of the heart. It is easy to comprehend, how, when they have been excited to inordinate action, that, as they have no repose to enable them, like the voluntary muscles, to recover the effects of fatigue, changes must, sooner or later, take place in their structure, which do not occur in those muscles which remain in a state of perfect rest after having been fatigued. Hence, as will be subsequently pointed out, whenever the heart's muscles have been over-excited, a circumstance which frequently happens, they require a distinct system of treatment. It is this unceasing action of the muscles which has a great influence in modifying the diseases of the other tissues which enter into the composition of the heart; for, when either the external covering or internal membrane, the pericardium or endocardium becomes inflamed, the inflammation cannot fail to be much increased by the unremitting action of the heart.

" It is remarkable that the muscles of organic life are not excited by powerful stimulants, or by injuries of the brain, as those of animal life. We constantly see convulsions and paralysis of the muscles of the extremities, but how seldom movements of the chest and abdomen. How unlikely, therefore, it is that the muscles of the heart—the centre of life—can ever be convulsed or paralyzed from diseases of the nervous system."

Bichat.

The Nerves of the Heart.

Hitherto we have been contemplating the great function of the circulation of the blood, as carried on by a simple hydraulic engine; but, like every other apparatus forming a component part of the animal structure, the heart is under the influence of the nervous system.

They are derived from two sources.

The nerves of the heart are derived from two sources,—from the *par vagum*, and the *great sympathetic*—or from the cerebro-spinal and ganglionic systems. In the embryo it is by the development of the cardiac ganglion where the great nervous system

The cardiac ganglion first formed in the embryo.

commences; so that the heart has been considered by physiologists as the *punctum saliens* of life. This important organ is therefore more or less under the influence of the brain, is supplied with motor and sensory nerves from the spinal chord, and likewise by nerves from the ganglionic system, by which it is associated with the organs of organic life.

The distribution of the cardiac nerves.

From the *cardiac plexus* branches are distributed to the different tissues of the heart, and numerous filaments are sent to the muscles, penetrate the muscular tissue, freely inosculate with each other, and are remarkable for the number of their ganglia. **Remack**

" All the ganglionic nerves which penetrate the muscles of organic life," observes the learned Bichat, " are not destined for these muscles alone, but numerous filaments belong to the arteries. These filaments form around the arteries a distinct nervous membrane. I compare this nervous membrane to the cellular envelope which is formed round the arteries, and which is distinct from that cellular tissue which surrounds them."

The heart is a central nervous organ.

That the heart is provided with a special nervous system, and that it may be legitimately considered as a " central nervous organ," is corroborated not only from the cardiac ganglion being the first part of the nervous system which is formed in the embryo, from its numerous ganglia in the different tissues of the heart, but also from the heart continuing to palpitate after the functions of the brain have ceased, and from its rythmic action continuing after it has been removed from a living animal. And further, if the **Paget.** trunk of the *par vagum* be galvanized, the action of the heart ceases; but if the cardiac plexus be galvanized, its action is increased.

This character of the cardiac plexus confirms Bichat's opinion, that the muscles of the heart are never *paralyzed* nor *convulsed;* and I am inclined to believe that they are never affected with acute rheumatism, rheumatic inflammation being seated in the pericardium.

Illustrated in the nervous system of animals.

The structure of the nervous system of the lower animals further strengthens the opinion which I have now offered, that the heart is to be considered a " central nervous organ." In many of the *invertebrata* nervous centres consisting of detached ganglia, or connected by nerve fibres, are placed in different parts of their body, each of the ganglia supplying a particular part, which part can act separately, or in conjunction with others. Each organ is independent of the brain, and can live after it has been separated from it, but whilst the body of the animal remains entire, all the organs perform their functions conjointly.

Differences in the influence of the brain on animal and organic life.

The influence of the brain on the organs of organic life is very different from its influence on those of animal life; hence it has been wisely ordained that when the brain is injured or diseased, the voluntary muscles may become paralyzed, or may be affected with convulsions, but those which are involuntary—those of organic life—are never similarly affected, so that the functions necessary for the support of the body may go on uninterruptedly. This difference, in the influence of the brain on the organs of animal and organic life, is also illustrated by the effects of medicinal substances, such as *opium* or *alcohol.* A person under the influence of opium or alcohol loses the power of the voluntary muscles, and is unable to use his limbs, but yet the heart continues to act with regularity. On the other hand, during the morbid action of the muscles of organic life, such as in those which takes place in palpitation and in vomiting, not only the brain but the muscles of animal life are seldom affected.

Bichat.

Sensibility of the heart.

Case mentioned by Harvey.

The heart has little *sensibility* during health, and its sensibility is seldom increased in disease. Harvey once met with an instance where the heart was exposed to view, in consequence of the sternum having become carious. On irritating the heart, it caused little uneasiness, being scarcely observed by the patient; thus exemplifying what may be frequently noticed, that when the heart is even seriously disturbed, there is little or no local pain, the uneasiness in breathing and the other symptoms arising from changes in the distribution of the blood.

The cardiac plexus associated with the ganglionic and cerebro-spinal systems.

However independently the cardiac plexus may perform certain functions, yet there are other functions of the heart which are associated with the cerebro-spinal and ganglionic systems. Whilst, therefore, we are inquiring into the functions of the heart, we must not only take into consideration those functions which depend upon and are regulated by the cardiac plexus, but also those which are under the influence of the cerebro-spinal and the ganglionic systems; and although the influence of these systems upon the heart be less powerful than the influence of the cardiac plexus, yet that influence is pointed out by many phenomena both in the healthy and the diseased condition of the circulation.

Recapitulation.

1*st*, That the heart receives the blood from the two *cavæ veins*, mixes it with the chyle, propels it through the lungs, and after being oxygenated in the lungs, and returned to the heart, it is circulated throughout the body.

2*dly*, The *capacity* of the cavities of the heart varies at different times; the heart receiving and ejecting more blood at one time than at another.

3*dly*, That the heart is a *double organ*, each heart performing distinct functions, and each having different diseases.

4*thly*, That there are *two bloods*, the red and the black blood, which materially differ from each other both in quality and quantity.

5*thly*, That the blood flows in *two circles*, "the greater and the lesser circulation," and notwithstanding the difference in the length of the two circles, means are provided so that the quantity of blood entering the heart and leaving it shall always be the same.

6*thly*, That the *two audible sounds* are caused by the currents of the blood, passing through the cavities of the heart.

7*thly*, That the *impulse* is caused by the "tilting" of the heart.

8*thly*, That the *auriculo-ventricular valves* of each heart perform very different offices; the valves of the right heart permitting the regurgitation of the venous blood, when the pulmonary artery is congested; and those of the left heart preventing any of the arterial blood regurgitating into the pulmonary veins.

9*thly*, That to prevent the regurgitation of the aortic blood into the left ventricle, in some animals, there are *supernumerary valves*.

10*thly*, That the *coronary arteries* are remarkable, in their origin, in their course, and in their distribution.

11*thly*, That the *pericardium* is composed of two distinct laminæ, the exterior being a serous membrane, and the interior a fibrous membrane.

12*thly*, That the *endocardium*, whilst it has a certain analogy to the serous membranes, is to be considered a membrane *sui generis*.

13*thly*, That the *action of the heart* is compound—in one movement the *black* blood passes from the right auricle into the right ventricle, and the *red* blood passes from the left auricle into the left ventricle; in the other movement the two auricles and the two ventricles act simultaneously.

14*thly*, That the heart, besides being supplied with *nerves* from the *cerebro-spinal* and *ganglionic systems*, has a special nervous system, and ought to be considered as a *central nervous organ*.

CHAPTER II.

ORGANS EMPLOYED TO REGULATE THE CIRCULATION.

The heart alone not sufficient to circulate the blood; variations in the supply of blood to different organs; the organs besides the heart which regulate the distribution of the blood. The arteries: differences in the mode of their distribution; differences in their length; and in the angles at which they leave the parent trunk; their different modes of ramifying; differences in their course; their tortuosities; their anastomoses; their plexus. The venous system: differences in the venous and arterial systems. The subcutaneous and the intermuscular veins. The venous sinuses in the dura mater *and in the* diploe *of the bones. The tortuosities of the veins; their anastomoses; their plexus.*

Contemplating the structure and functions of the central organ of the circulation, for the purpose of elucidating the nature of its various diseases, it is essential, that our researches should not be limited to the functions of the heart alone, but that such inquiries should be extended to those organs which are intimately associated with the heart, and which materially contribute to the distribution of the blood.

Heart alone not sufficient to circulate the blood.

Though it may be strictly true, that the arterial blood flows in one great circle, and that the heart, like a syringe, has sufficient muscular power to propel the vital fluid throughout the whole system, yet there are other physical conditions necessary for the due performance of that function—conditions to which we must constantly refer in all our pathological researches. Important as was the great discovery of Harvey, yet it is apparent, from the differences in the arrangements which are found in the arteries, in the veins, and in the capillaries, that the red blood, besides flowing throughout the body in a circle, must have the impetus and the direction of its currents modified. We therefore find that it is not only indispensable, that a certain

Variations of the supply of

blood to different organs.

quantity of blood be sent to every part of the body, but that the supply to the different organs be variously changed. In some organs, it is requisite that such supply be equal and uniform, whilst in others it is necessary that on certain occasions the quantity of the vital fluid be either diminished or increased.

Supply to the brain uniform; and to the erectile tissues.

Of the first of these conditions, there is an example in the *brain*, for the due performance of whose functions, the circulation must be uniform; and of the other, we have an illustration in the *erectile* tissues, those being employed in certain parts for the sole purpose of varying or altering their form, in order to facilitate the organs, to which they belong, to perform a particular function. Hence the erectile tissue of the nipple becomes injected with blood, to enable the infant to withdraw the milk from the lacteal tubes.

The circulation is modified by vital causes.

But the office, either of diminishing, or of increasing the quantity of blood, in certain parts of the body at particular times, is a function of the circulation not depending alone upon the heart, but also on the *nervous* system. When food is taken into the stomach, its vessels become more replete with blood. When the intellectual powers are excited, an additional quantity of blood flows into the brain: the same takes place in the erectile tissue of the *corpora cavernosa*, and in the vessels of the uterus and testes, whenever these organs are called upon to perform their respective functions.

In like manner, we shall find that the *heart* itself requires a different quantity of blood in its various conditions; hence it becomes an interesting subject of inquiry to discover how that supply of the vital fluid to the heart is furnished with the requisite regularity;—a function which, I shall endeavour satisfactorily to demonstrate, is performed by the *muscles* or organs of active motion.

Organs employed in the circulation besides the heart.

For thus modifying the distribution of the blood, it will appear, that, besides the influence of the nervous system, there are employed no less than *five* other organs, as well as the heart: the *arteries*, the *capillaries*, the *veins*, the *muscles*, or organs of active motion, and the *respiratory organs*. The co-operation of these different organs for carrying on the circulation of the blood, when the body is in health, renders it essential, that in prosecuting our pathological researches, the share which each of them has in executing that important function should be separately considered; for it is evident, that, as the healthy circulation depends on the due performance of the natural functions of these different organs, so it will happen that disorders of the heart must modify their functions; and, on the other hand, that changes in their functions must influence the functions of the heart.

Advantages derived from comparative anatomy.

When investigating this interesting subject, comparative anatomy affords great assistance; peculiarities in the sanguiferous system being found in different tribes of animals, varying in particular organs, according to the element in which they dwell,—whether inhabitants of the air or the waters—whether amphibious, graminivorous, or carnivorous,—whether remarkable for speed like the deer, or slow-moving like the sloth,—whether the bird that flies near the surface of the earth, or the eagle that soars many thousand feet above it,—or whether the fish that lives in shallow water, or the whale that descends to a vast depth below the surface of the ocean. To enable these different tribes of animals to execute the purposes for which they are destined in the creation, remarkable peculiarities are found in the arrangement of the sanguiferous system; a knowledge of which will materially assist in elucidating the great function of the circulation of the blood.

The Arteries.

The arteries, whether by an elastic power alone, or by elasticity and muscularity combined, lend the heart an important aid in conveying the blood to the capillaries. I have already stated, that it is not requisite that the red blood should be transmitted to all parts of the body with the same velocity, or, that the supply to the different organs should be at all times uniform. These purposes, as well as to provide for the exigencies which certain organs may demand, when, from our habits or avocations, the circulation becomes disturbed, are all fulfilled by particular modes in the distribution of the arteries. And the coats of the arteries are beautifully contrived, by their elasticity, to admit either of an increase, or of a diminution in their calibre, by which they can accommodate themselves to the constant changes which are taking place in the currents of the vital stream.

As the heart has not the power to direct any extra quantity of blood more to one part of the body than to another, that office is performed by various contrivances in the arrangement of the arteries, by which the impetus of the blood's stream is increased, or diminished, and also by changes in the functions of the proper vessels of the organs,—their *vasa propria*,—being influenced and regulated by the nervous system. The arteries also, are as essential for carrying on the circulation as the heart itself. When the arteries of a limb become diseased, the limb perishes, whereas great changes may take place in the structure of the heart, and still the blood continues to be circulated through the arteries with sufficient regularity for the maintenance of life.

Burns on the heart.

Difference in their length.

The *length* of different arterial trunks,—the different *angles* at which the branches leave the trunks,—the *tortuosities* of different trunks,—the *anastomoses* and *plexuses* of arteries,—the varieties in the *course* of arteries, and in their calibre,—the different modes in which they *ramify*,—are peculiarities of arrangements in the arteries, all of which are calculated to modify the circulation of the blood in particular organs.

Different modes in which arteries ramify.

The ramifications of arteries.—The different modes in which arteries ramify in the various tissues is very remarkable. Thus, the arteries of the intestines have been compared to the *branches of a tree*, those of the tongue to a *hair pencil*, those of the liver to a *star*, those of the spleen to a *sprinkling brush*, those of the choroid plexus to *a lock of hair*, those of the schneiderian membrane to a *trellis-work*, and those of the muscles to a *bunch of twigs*. But the office for which each of these peculiar modes of ramifying is intended is not known; though, doubtless, they must effect great changes in the circulation of the blood.

Ruysch

A remarkable difference in the *length* of arteries is exemplified in the renal and spermatic vessels.

In the angles at which they ramify.

In the *angles* at which the arteries ramify, there are also considerable varieties. "To keep up a velocity in the blood sufficient for the parts and no more, nature has carried the angles of the origin of arteries to different distances from the source of circulation." The intercostal arteries divide at right angles, and the spermatic arteries at a very obtuse angle. Some arteries *enlarge* as they approach the organ to which they are distributed. "The arteries of the placenta evidently increase in bulk as they

Difference in their calibre.

Hunter.

approach the placenta. In the spermatic artery of the bull it is an increase equally evident as they approach this gland."

In their course.

The *course* of some arteries is remarkable, and shows the ingenious contrivances by which they are protected from the movements of the contiguous parts. Thus the *vertebral* arteries pass through a *bony* canal; the arteries of the *heart* pass along a *tendinous furrow* between the auricles and the ventricles; the *aorta* passes through a *tendinous ring* in the *diaphragm;* the *femoral* artery passes through an *opening* in the tendon of the *triceps muscle;* and the arteries of the hand pass under the strong aponeurosis of the wrist,—by all which contrivances these vessels are protected from the pressure of the adjacent muscles during their contractions.

For a similar purpose, the artery in the tail of the *prehensile monkey* passes through a canal in the vertebræ, so that when the animal, according to its habits, suspends itself by the tail on the branch of a tree, the artery is secure from all pressure, and the circulation of the blood is not interrupted. "Among the branches of trees their agility is almost equal to that of a bird; the sensible tip of the long tail seizes a branch with the facility and security of a fifth hand, whilst its grasp is sufficiently powerful to support the weight of the body as it swings from bough to bough."

Gosse on the Mammalia.

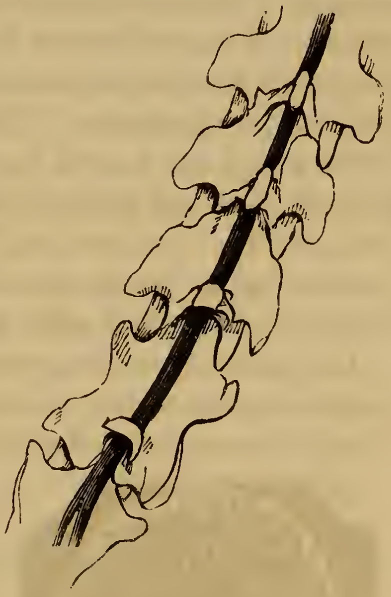

Fig. 9.

The arteries in the tail of the *shark* afford another illustration of arteries being protected in those animals whose habits expose the artery to undue pressure. In this animal the arteries of the tail pass through a bony canal of the vertebræ, so that, when the creature makes use of its tail as an instrument of defence, the hurtful effects of a violent blow on the circulation are warded off by the protection afforded to the arteries.

In other animals, such as the *cat*, *lion*, and *sloth*, the humeral artery passes through a *foramen* in the *humerus* (*a*, *a*), so that in these animals, which grasp their prey, and hold it firmly in

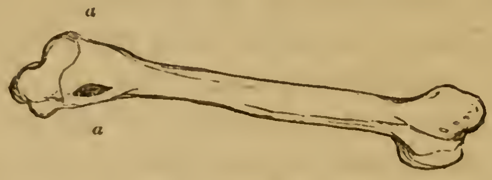

Fig. 10.

their paws for a lengthened time, the bony canal, through which the artery passes protects it from all pressure, and thus the circulation in the vessel is not impeded.

The anastomoses of arteries.—Anastomoses are found in all ramifying systems, in the arteries as well as in the veins, in the lymphatics, and in the nerves.

The purposes of anastomoses.

The anastomoses of the *arteries* fulfil different purposes in the economy; for although the heart propels the blood with a certain velocity, the modifications in the circulation produced by their numerous anastomoses must diminish in a greater or less degree the blood's momentum. The anastomoses of arteries, such as those which are formed by the coronary arteries of the *heart*, *stomach*, *lips*, and *iris*, and the inosculations between the *carotids*, forming "the circle of Willis," and of the *vertebrals*, forming the basilar artery, are all modifications in the distribution of the arteries, which serve essential purposes in the circulation.

In the heart the ring formed by the anastomosis of the two large branches of the *coronary arteries*, must enable the circulation in them to proceed uninterruptedly, and not to be disturbed by the unceasing movements of the heart's parietes. The arteries of the *iris* and *eyelids*, of the *lips*, *intestinal canal*, and *hand*, all afford examples of anastomosis, by which an impediment to the flow of blood in any of these vessels may be compensated for by the supply from the anastomosing branches.

Fig 11.

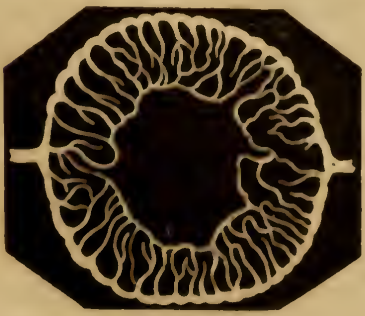

Fig. 11.

Anastomosis of the two vertebrals.

A very different purpose is, however, served by the anastomosis of the *two vertebral arteries*, forming the *basilar* artery; and also by the anastomosis in the *spinal arteries*, and though evidently intended for some essential purpose, yet no one has offered any explanation of their use.

In the basilar artery.

The *basilar artery* not only secures a due supply of blood to the arteries of both hemispheres of the brain, but it appears to me that it likewise supplies all the branches with a uniform current of blood. The collision of the two streams of blood in the vertebral arteries, when they meet in the basilar artery, must be very considerable. If two billiard balls, moving in a straight line, and with an equal velocity meet together, their motion is completely destroyed. Hence, by the collision of the two streams of blood of the vertebral arteries, the velocity of the stream in the basilar artery will be diminished in the ratio of the angle at which the two streams meet. Thus, both hemispheres of the brain will be supplied with a uniform current of arterial blood.

Anatomy of the spinal arteries;

Anatomy further reveals a peculiarity in the arteries of the *spinal chord*, which is as essential to bear in mind, whilst prosecuting our pathological investigations on the nervous system, as that of the arterial circulation of the brain. I am not aware that this important arrangement of the spinal arteries has ever been noticed by any of those inquirers, who have bestowed much assiduity in investigating the functions of the *cerebro-spinal* system.

The anatomical fact to which I allude is, that a similar arrangement to that which is resorted to by the economy for securing an equal supply of blood to the whole brain, is employed to fulfil a similar office to the *spinal chord;* and consequently that the spinal chord, like the brain, must be influenced by disturbances in the action of the heart. Hence arises an assemblage of *symptoms*, in the diseases of the heart, which, I will endeavour to establish, are as important an addition to semeiology, as those derived from the brain itself.

are branches from the vertebrals.

Their anastomoses.

It has been shown, and "the parts accurately delineated by Haller," that the prolongation of the spinal chord, from its exit through the cranium to its termination in the *cauda equina*, is supplied with blood chiefly by the *spinal* arteries; the spinal arteries coming off from the vertebrals immediately after these vessels enter the *foramen magnum* of the occipital bone,—one branch from each trunk forming the anterior, and another branch from each trunk forming the posterior spinal artery.

The spinal chord, it ought to be recollected, like the brain with its carotids and its vertebrals, has, besides the spinal arteries, small anastomosing branches from the parent trunk, from the *intercostal*, from the *sacral*, and from the *lumbar* vessels; so that any interruption to the circulation in the spinal arteries may be compensated for by a supply of blood from these other channels.[1]

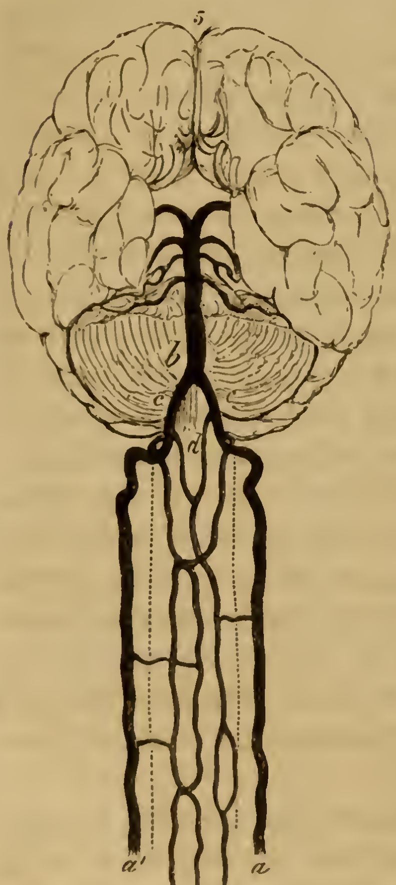

Fig. 12.

Cerebro-spinal system supplied with blood from one channel.

The spinal chord, like the brain, is therefore supplied with blood almost entirely by arteries; the circulation through which can never be interrupted by any movement of the adjacent muscles, whilst, like the brain, it must be influenced by every change in the action of the heart.

Physiological inferences.

The circumstance of the whole *cerebro-spinal* system being supplied with blood from the same channels, so that the circulation shall be always modified in both of the great nervous centres at the same moment, and whenever there is any change in the action of the heart, is a fact highly important to physiology, and will materially assist in explaining the intimate association in the functions of these two subdivisions of the nervous system; whilst it will, at the same time, elucidate many interesting pathological phenomena. Thus, we have obtained an additional proof of the unity of the brain and spinal chord, as one great nervous system; and we can now explain how, in many disturbances of the heart, such as those which accompany febrile diseases, the two nervous centres with the nerves emanating from them are so often simultaneously affected.

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[1] This peculiarity in the arrangement of the arteries of the cerebro-spinal system is illustrated by the figure. The two vertebral arteries (*a*, *a'*) ascend parallel to the spinal chord, which is represented in dotted lines pass over the cerebellum, and inosculating with each other at (*b*), where they form the basilar artery. A little anterior to the union of the vertebral arteries two branches (*c*, *c*) and (*d*) come off from each trunk, which form the *anterior* and *posterior* spinal arteries.

Although these peculiarities in the course, and in the distribution of the arteries of the cerebro-spinal system have been long known, yet the purposes which they serve in the economy have certainly not been at all understood; nor, indeed, could they have even been conjectured, far less satisfactorily explained, until the *musculo-cardiac* function was demonstrated. It is, indeed, remarkable, that ever since the peculiar course of the arteries of the brain was first described, up to the present period, physiologists should have, one after another, been satisfied with giving nearly the same unphilosophical explanations of the purposes of this singular vascular distribution; some conceiving that the osseous canals, through which the vertebral arteries pass, merely served the purpose of a protection from external injuries, and others conjecturing that this peculiar arrangement was intended to prevent any undue increase in the size of the vessels.

To accomplish a similar purpose as that of anastomosis, some important organs are supplied with branches from *several trunks*, such as the brain, with its two vertebral and two carotid arteries, the stomach, with its branches from different trunks, and the eye, with branches both from the internal and external carotids.

In some arteries of animals.

There are also anastomoses in the arteries of some *animals*, which must serve an essential purpose in the circulation. "In the *amphibia* there is an arterial trunk which inosculates with their two aortæ." "The same mode of anastomosis, as that between the carotid and vertebral arteries, takes place in some of the amphibia between the two descending aortæ."

Hunter.

Brain supplied with a large proportion of blood

Besides the peculiarities in the arrangement of the arteries of the brain and spinal chord, all of which are intended for securing to these organs a uniform supply of the vital fluid, it is also of importance to notice the proportionably large quantity of the mass of the blood which goes to the cerebro-spinal system, as this will materially assist in explaining, how that system is affected, more perhaps, than any other, when the functions of the heart are disturbed.

Haller's calculation.

If Haller's calculation be correct, or if it be even an approximation to the truth, that the weight of the brain is about seven pounds in a body weighing two hundred pounds, and that one-sixth of the whole mass of blood goes to the brain, then the brain must be supplied with nearly five times more blood than any of the other parts of the body.

Anatomy of the carotid arteries.

Having said thus much on the anatomy of the *vertebral arteries*, and having adverted to the unsatisfactory opinions that have been offered as to the purposes of their peculiar course and mode of distribution, it may be fit, also, to call the attention of the reader to some peculiarities in the *carotid* arteries; as it must appear strange, that, if such decided means were required in order to insure an uninterrupted circulation in the vertebral, that the carotid arteries should be so much exposed to external injury, and their circulation to so many interruptions from the contractions of the muscles of the neck.

It seems, however, that the same protection to the circulation, so requisite for the vertebrals, is not wanted in the carotids, although a much larger proportion of the blood which goes to the brain is supplied by the internal carotid arteries. The external carotid is distributed upon the neck, the face, and the coverings of the brain; but the internal carotid conveys to the brain itself a large tributary stream of the vital fluid. In animals, however, of so little importance is the supply of blood by the carotids, compared to that of the vertebrals, that, when a ligature is placed on one of these vessels, no particular symptoms supervene; and even "when both carotids have been tied, the animal neither died nor appeared to be very uneasy." Whereas, when the vertebral arteries of rabbits are compressed, it is followed by instant death.

Haller.

Astley Cooper.

Before concluding these remarks on the peculiarities in the arteries of the brain, which I have deemed it essential to bring together in conducting our inquiries on the pathology of the heart, there are likewise some peculiarities in the structure of these vessels, and in their mode of distribution, after they have entered the cranium, which are equally worthy of notice.

Cerebral arteries—structure of.

"All the branches of the cerebral arteries contained within the skull have a thin, solid, and more brittle substance than the other arteries of the body; and as the size of these vessels cannot be diminished, from the incompressible nature of the cerebral

Haller.

pulp, they do not require to possess those powers of dilatation and contraction like the arteries of the external and soft organs."

Trans. of the Med. and Chir. Society.

Although there is a free inosculation of the large branches of the cerebral arteries, it is remarkable that there is no *anastomosis* of their branches, after they enter the cerebral pulp; the consequence of which is, that if, from disease, one of the branches be obstructed, that portion of the brain only which is supplied by it perishes, and its functions cease—an important fact which has been distinctly shown by numerous dissections of Dr. Kirkes.

Pathological inferences.

From the very peculiar arrangements and distribution of the vertebral arteries which have been pointed out, it appears to me legitimate to conclude, that, as means are employed by the economy to provide the brain and spinal chord in the healthy condition of the body, with a uniform supply of blood, so it must happen, that, when the regularity of the heart's functions are disturbed, the cerebro-spinal system will suffer more than any of those systems, for the due performance of whose functions such uniform supply of the vital fluid is not necessary;—hence it is, that many of those disorders, which are so frequently supposed to commence in the head, are, in fact, caused by a disordered heart.

On these grounds, I shall hereafter endeavour to account for the unnatural sounds, false images, vertigo, inability to balance the body, and various disturbances in the functions of the cerebro-spinal system, which so frequently, nay, almost invariably, accompany diseases of the heart; all changes which become useful diagnostic symptoms in these diseases, and serve to establish a rational system of treatment.

Ratio of the comparative size of the carotid and vertebral arteries in animals.

Comparative anatomy assists us in this, as in most other physiological inquiries. It appears that, throughout the different races of organized beings, the magnitude of these two sets of vessels, the carotids and the vertebrals, always has a certain ratio to the brain of the class of animals to which they belong; and in proportion as the anterior or intellectual part of the cerebrum is small, the size of the carotids diminishes in the same proportion, on the other hand, as the anterior portion increases, so the carotids become large.

Effects of long necks.

"It is a general remark, that animals with long necks, in which the brain is necessarily far from the heart, the heart cannot excite the brain so vigorously; that their intelligence is also more limited, and consequently the cerebral functions are more narrowed. On the contrary, those animals which have short necks, and consequently in which the brain and heart more closely approach, commonly have a corresponding mental energy. Mankind, who have the head placed far above the shoulders, compared with those in whom it is very close, sometimes offer the same phenomena." Bichat.

"A Roman Emperor, to show the certainty of his hand, did shoot a great forked arrow at an ostrich as she ran swiftly upon the stage, and struck off her head; and yet she continued to race a little way with the head off." Bacon.

Each vessel when disturbed, causes different symptoms.

Further, as each of the cerebral vessels supplies different portions of the brain—the internal carotids conveying the blood to the anterior, and the vertebral arteries supplying chiefly the posterior lobes, the cerebellum, and the spinal chord,—it may be anticipated that, whenever the circulation, in any one of these vessels, or pairs of vessels, is disturbed, different symptoms will be manifested, according to the portion of the brain which is supplied by the particular artery.

Arteries of the membranes of the brain and spinal chord.

When inquiring into the peculiarities of the arterial circulation in the cerebro-spinal system, we should not omit noticing those of the *membranes* by which it is surrounded, as their vascular connexions must have a considerable influence on some pathological phenomena.

Now, we find that the same provisions, which are employed to secure a due supply of blood to the brain, are also found in the *dura mater*, that membrane receiving branches from both the external and the internal carotids, and also from the vertebral arteries. In a similar manner, the coverings of the spinal chord are supplied with blood, as the chord itself, branches from the spinal arteries, the intercostal, lumbar, and sacral arteries, being all ramified on these membranes.

The plexus of arteries.—The arterial plexus found in man, examples of which are still more remarkable in some of the inferior animals, is also a mode by which arteries are arranged to fulfil important purposes in the circulation of some organs. The arterial plexus is formed by an artery dividing into numerous branches, and these branches reuniting and forming one trunk. The *choroid plexus*, the plexus in the arteries of the *mesentery* and of the *placenta*, are examples of the arterial plexus.

The *rete mirabile* of Hovius.

Fig. 13.

In the opthalmic artery of *diving birds*, there is a remarkable arterial plexus, which prevents their sight from being impaired by the pressure of the column of blood on the eye, when these animals plunge deep under water in search of food.[1]

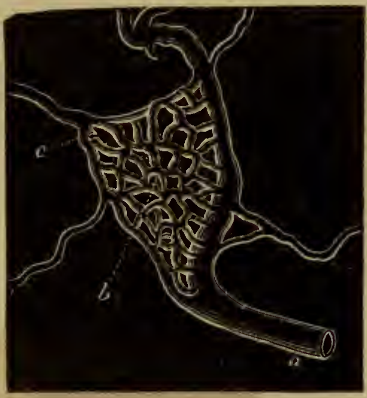

Fig. 13.

The *rete mirabile* of Galen.

Fig. 14.

In the *graminivorous* animals, whose heads are kept constantly in a dependent position whilst feeding, a like purpose is served by a plexus of the internal carotid artery.[2]

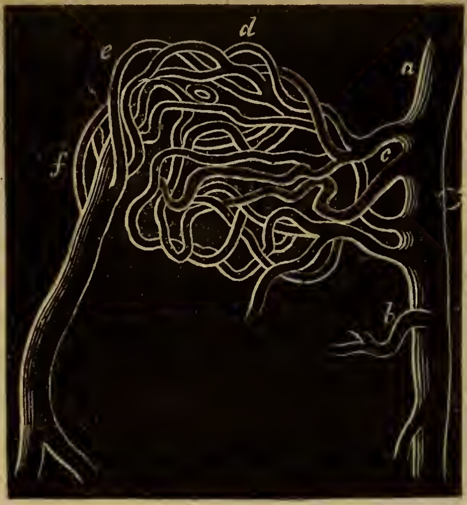

Fig. 14.

Plexus in the lion.

In the *lion* the internal carotid artery forms a plexus before it enters the cranium.

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[1] Fig. 13. (*a*, *a*) Branches of the carotid artery, from which is derived the plexus. (*b*) The plexus, of a triangular form. From its base innumerable small branches arise, which unite at the opposite angle (*c*).

[2] Fig. 14 represents, in a *fœtus calf*, the plexus formed by the internal carotid artery, called by Galen the *rete mirabile*. (*a*) is the top of the common carotid artery, (*b*) the external carotid arteries, (*c*) several arteries which supply the place of the single internal carotid in man, (*d*) numerous small serpentine branches into which these arteries are subdivided in their progress through the cranium, (*e*) these branches joining again into (*f*), the principal trunk of the internal carotid artery within the head, and which afterwards divides into branches, resembling those in man.—Monro.

Hovius.

CHAP. II.

In the sloth. Fig. 15.

A remarkable plexus is formed in the brachial artery of the *sloth*,—a plexus evidently intended for a very different purpose from any of those which have been mentioned. In this singular creature the *brachial artery*, after passing through a foramen in the *humerus*, divides into numerous branches, which afterwards reunite, so that when the animal clings to its prey, or to the branch of a tree, which it is in the habit of doing for a very lengthened time, the pressure necessarily made on its arms cannot interrupt the circulation of the blood.

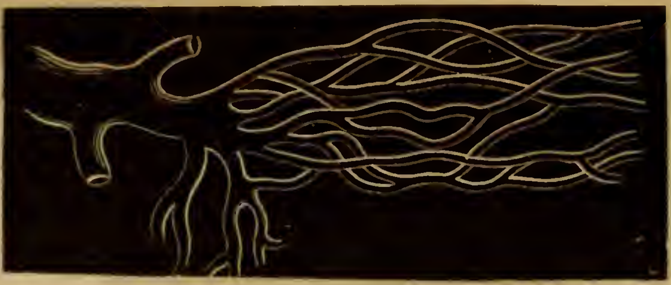

Fig. 15.

The intercostal plexus in aquatic animals.

Some *aquatic animals*, whose habits render them subject to great vicissitudes of pressure, from the depth of the waters in which they dwell, having sometimes to support the weight of six or seven atmospheres, are also provided with a special apparatus, or *rete*, which appears to be intended to guard them against the pernicious effects of that congestion in the heart, which would otherwise be caused by the stoppage of the capillary circulation in the exterior of the body.

In the *whale*, *dolphin*, and other cetaceous animals, the intercostal, and also the spinal arteries, form a very extensive *plexus*, these vessels dividing into many tortuous branches, which again reunite; so that when the animal plunges into very deep water, the pressure of the superincumbent medium must diminish, and even retard altogether the blood's flow into the exterior vessels of the body, causing it to accumulate within the great cavities, more especially in the chest. It will then collect in the vascular network of the intercostal arteries as in a reservoir, from which it will again flow to the surface of the body whenever the animal emerges from the deep.

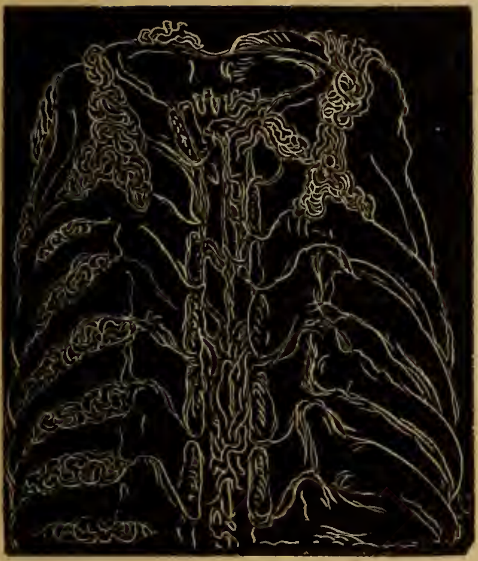

Fig. 16.

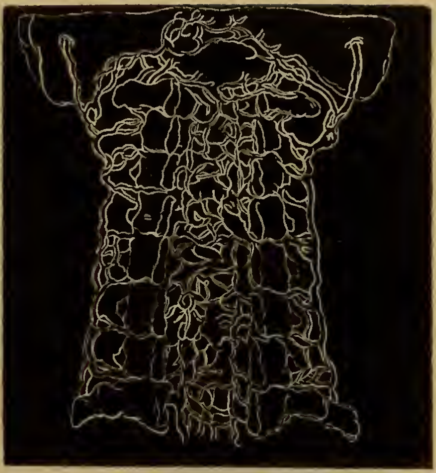

Fig. 17.

See Histoire Anatomique d'un Organe Vasculaire dans le Cétace.

This plexus was first described by John Hunter, and subsequently a more detailed account of it has been given by Breschet, though he has attributed to it a very different use in the economy from what I have now offered.

Their purposes.

The tortuosity of arteries.—Some arteries become tortuous before they reach the organ which they supply with blood, and these tortuosities appear to serve different purposes in the circulation. The tortuosities of the arteries of the *uterus* (fig. 18), *testis*, and *spleen*, must cause essential changes in the transit of the blood; as during the functions of these organs, they require an additional quantity of blood, the tortuous course of the arteries, and also the increase in their calibre, which likewise takes place before they reach their respective organs, will not only diminish the velocity of the blood's stream, but will act as reservoirs—thus providing the organs to which they belong with an additional supply of blood, when such an additional supply is required.

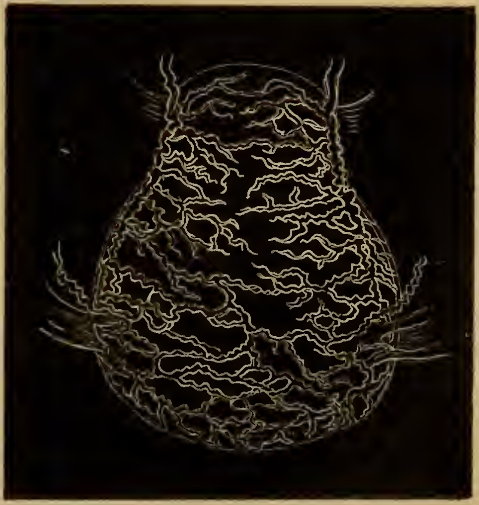

Fig. 18.

CHAP. II.

The arteries of the uterus.

Hunter

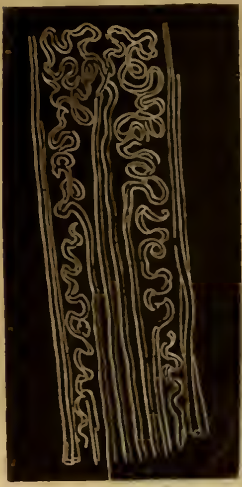

Fig 19.

The arrangement in the arteries of the *uterus* must be subservient to the functions of menstruation and gestation; "the uterine arteries are enlarged very considerably, which throws them into a serpentine course, that must retard the blood's motion to the part." The tortuosities, and increase of the size of the spermatic, and of the renal artery, must be equally essential for the due performance of the functions of the *testes*, and of the kidneys (fig. 19). The tortuous course of arteries also answers the purpose of accommodating themselves to the varied positions of the organs to which they belong, such as those of the lips, testes, and intestines.

Tortuosities of the arteries of the brain.

A very important purpose, I apprehend, is served by the tortuosities in the arteries of the *brain* (fig. 20), a purpose which does not accord with what has been hitherto conjectured by anatomists.[1]

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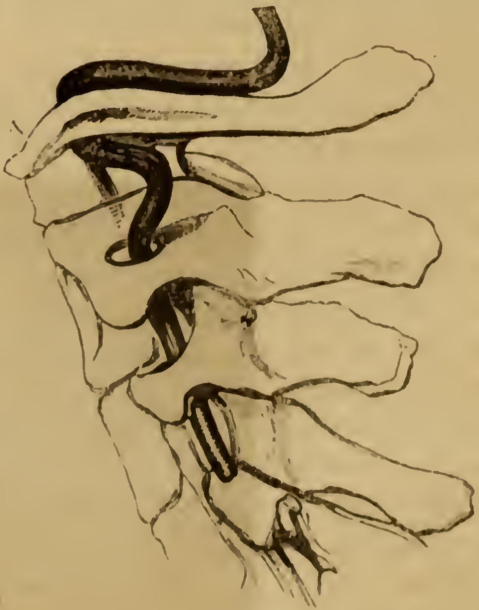

Fig. 20.

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[1] The *tortuosities* of the cerebral arteries. "This character of the curvatures, long since observed by anatomists, has given rise to a physiological assertion, almost universally adopted, as regards the circulation of the blood within the head. It has been said that the curvatures of the cerebral arteries are intended to diminish the force of the blood currents—a force which the soft and delicate substance of the

Erroneous notions of their use.

That such tortuosities in these vessels can materially alter the velocity of the current of the blood, before it enters the brain, which has been usually supposed to be the effect of their serpentine course, is not the case; for it is clearly demonstrable, that even very considerable bendings in a tube cause so little diminution in the velocity of the current of a fluid passing through the tube, that such diminution is scarcely calculable, and is not even taken into account by practical engineers. Any such explanation of the use of the serpentine course of the cerebral arteries is, therefore, quite untenable, and we must look for some less objectionable explanation of this peculiar vascular arrangement.

Explanation of the author.

To me it appears, that the tortuous course in the arteries of the brain is solely intended to prevent the additional pressure which would be caused upon the brain, by the weight of the column of blood, when the head is bent downwards, if these vessels were perfectly straight. In some of the lower animals, whose habits require the head to be kept for a long time in a pendent position, besides a serpentine course of the vessels, further means are resorted to for performing a similar office in the circulation. Thus, in the *graminivorous* tribe, as has been already mentioned, the carotid arteries form a *plexus*, dividing into numerous branches, which afterwards reunite; and in *diving birds*, whose heads are often placed downwards when the animal is in search of food, there is a plexus in the ophthalmic artery, which, like that in the graminivorous animals, will counteract the additional pressure of the column of blood on the eye,

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brain could not endure, had that organ received the blood in a direct line. But to admit that these vascular tortuosities can retard the stream of blood, the arteries must be supposed to be empty at the moment when the heart contracts. One then can conceive how the flow of the blood pushed forwards by that contraction, and having a tendency to escape always in a straight line, should be retarded by the curvatures in proportion to their number. On the contrary, if this supposition is inadmissible, and if, as cannot be doubted, the arterial system is constantly filled, the movement communicated to that mass of blood continued by any action of the heart, cannot be diminished by the tortuosities, and will be just as great at the extremities of the vessels, whatever may be their form, as at their origin. The degree of impulse which the circulation communicates to an organ is therefore in proportion to the quantity of the blood which is carried to it, and not according to the direction of the vessels which transmit it. I am *ignorant of the relation which the curvatures of the cerebral arteries have with the circulation of the blood in the brain, and I have noticed the circumstance here without drawing from it any conclusion.*"—Bichat, *Anat. Des.*

which would otherwise be produced from that attitude of the head.

This is, no doubt, the chief function of the tortuosities of the internal carotids, although an additional purpose, I am inclined to believe, is obtained from the curvatures in the *vertebra* arteries. In their passage along the vertebral canals, until they reach the second cervical vertebra, the vertebral arteries cannot be influenced by any movement of the spinal column; for there is no degree of rotatory motion in the lower cervical vertebræ, but merely a slight gliding, or sliding motion obliquely backwards and forwards. When, however, the vertebral arteries reach the second cervical vertebra, and make two turns, before entering the *foramen magnum* these turns are so directed, that whatever movements are made by the head on the first vertebra, or by the first and second vertebræ on each other, the passage of the blood through the arteries can never be interrupted.

See fig. 20.

Additional use of curvatures.

There is a peculiarity in the internal *carotid* arteries, besides their tortuosities, worthy of notice, which, as physiological science advances, may explain some pathological phenomena which we do not yet comprehend. No sooner have these vessels entered the osseous foramina, destined for their passage within the cranium, than they ascend to the *sella turcica*, " where they are naked and bathed in the blood of the cavernous sinus." What purpose this serves in the economy has never been even conjectured, though we cannot doubt, but that this singular arrangement performs some important office: and the circumstance of a small branch of the sixth pair of *nerves*, which commences the great sympathetic nerve, being also bathed in the blood of the sinus, renders this structure still more remarkable.

Carotids bathed in the blood of the cavernous sinus.

The Capillary System.

The capillary system performs all the important functions of incretion and of excretion; whereas the heart, with the arteries and veins, though under the influence of the nervous system, is a pure mechanical apparatus employed merely for conveying the blood to the different organs, and receiving it, after certain of its elements have been separated from it, in order that it may be replenished with chyle prepared by the digestive apparatus, and again oxygenated by the organs of respiration.

The functions of the capillaries, as well as the phenomena which they manifest in diseases, point them out as a distinct system of vessels intermediate between the arteries and the veins, and though intimately related to, and under the influence of, the heart, they are yet independent of its actions. " If the heart of a frog be removed from the body, the capillary circulation continues."

Bichat.

To execute their various functions, the capillaries present different structures and arrangements, each organ having its special capillary circulation, by which, under the immediate influence and control of the nervous power, they form a *vital laboratory*, in which are compounded and separated from the blood the elements which are necessary for the life and growth of the living being.

The Venous System.

The functions of the veins.

Although the offices of the veins are subservient to those of the arterial and capillary systems, the veins being chiefly employed in returning the blood to the heart, after it has been deprived of certain elements by the organs of secretion and excretion, mixed with the chyle, and oxygenated in the lungs, yet there are several special functions performed by different subdivisions of the venous system, and also by the veins of some organs.

Their importance in the circulation.

When investigating the phenomena of the circulation, we ought, therefore, to examine not only the various contrivances by which the arterial blood is supplied, and its currents modified, in different parts of the body; but with equal care should we examine the arrangement of the venous system—a system which has as great a share in the pathological condition of the right, as the arterial system has in the left heart. In pursuing our inquiries on this subject, it will appear that although the offices of some portions of the venous system have been satisfactorily explained, yet there are peculiarities of veins in the inferior animals, as well as in man, which, though long known to anatomists, yet the purposes they serve in the circulation have not hitherto been explained.

Differences in the functions of the venous and arterial systems.

Though the venous system has a certain resemblance to the arterial, yet there are striking differences in their functions, as well as in their structure.

A remarkable difference in the function of the two systems is, that the stream of blood in the arteries flows from the trunks to the branches, whereas the blood in the veins flows from the branches into the trunks: and though the pulse of the arteries gives important information of the state of the heart, no such information is afforded by the veins.

Another striking difference in the offices of the arterial and venous systems is, that the quantity of blood in the arteries depends on the velocity with which it is ejected from the left ventricle, so that according to the heart's vigour will the quantity of blood in the arterial system be increased or diminished. But the quantity of blood in the veins depends on the hindrance which the venous blood meets with before it reaches the heart, and on their powers of distention, permitting a great increase in their area.

Differences in their structure.

There is likewise a corresponding difference in the structure of the two systems of vessels. In place of the strong elastic coat of the arteries, that of the veins is much thinner, more dense, and less elastic, so that these vessels are capable of great distention, and can thus act as reservoirs, or *diverticula sanguinis*, being able to receive various quantities of blood at different times, as particular organs may require.

The inner coat of the veins is extremely thin, and is less fragile than the inner coat of the arteries; neither is it torn when a ligature is applied to a vein, as takes place with an artery.

The cerebral veins consist wholly of this membrane, but in the sinuses of the *dura mater* this tunic is entirely wanting.

In some veins, as in the termination of the cavæ, there are muscular fibres, as well as in some veins of the lower animals. In the wings of the *Bat*, which, from their great length in proportion to the bulk of the body, the power of the arteries not being sufficient to circulate their blood, the veins possess a muscular power.

Jones.

The number of veins.

The aggregate number of veins in some organs is greater than the number of the arteries, in other organs the veins are less—and in others the number of each system of vessels is equal. In the stomach, intestines, spleen, kidneys, and ovaria, the number of veins and arteries is nearly equal; but in the cerebral, spinal, and portal systems, compared to that of the arteries, they are more numerous. Hence the momentum of the blood's current will be diminished in proportion to the calibre of the two sets of vessels.

In the cavernous bodies, the veins are even less numerous than the arteries, and the subcutaneous veins have no corresponding arteries.

Tortuosities of the veins.

The tortuosities of the veins are more numerous than those of the arteries. However inexplicable the office of the remarkable tortuosities of the veins of the *uterus* (fig. 21), *testis*, and *spleen* may be, they must undoubtedly co-operate with the heart, arteries, and capillaries in modifying the circulation of the blood in the respective organs to which they belong.

Of the uterus.

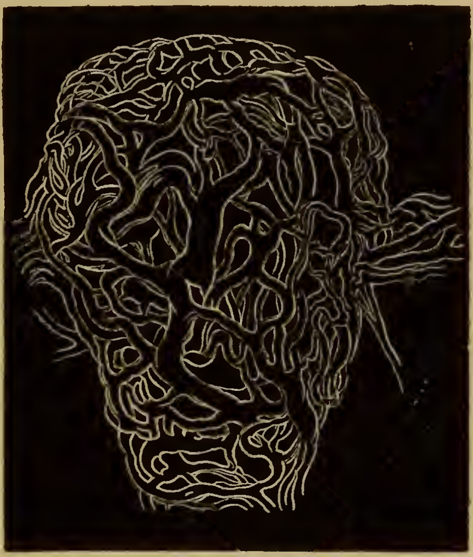

Fig. 21.

Their anastomoses.

The *anastomoses* of the venous system are far more numerous than those of the arterial system. The aggregate area of the veins being greater than that of the arteries, their remarkable power of dilatation, their superiority in number, as well as their anastomoses, enable those of different organs to receive various quantities of blood at different times, and materially to contribute to preserve the due balance of the circulation in the sanguineous system.

The plexus of veins.

The *venous plexus* are likewise more numerous than the arterial, and are intended to fulfil very different purposes. To discover these purposes, we must inquire into the functions of the organs to which they belong, not only in man but in the inferior animals: for as the different classes of organized beings have all their special habits and necessities, to enable them to serve the purposes in the creation for which they are destined, each class is endowed with an appropriate organization.

The most remarkable venous plexus in the human body, are those of the chylopoietic viscera, and the genito-urinary system of both sexes. The venous system of the spleen, liver, and of the alimentary canal, is capable of containing various quantities of blood, the supply of the vital fluid varying in the different stages of the digestive process. The veins of the genito-urinary system, in both sexes, not only serve the purpose of returning the blood to the heart, but, by their powers of distention, they change the form of the erectile tissues of the organs of that system, so as to enable them to perform their respective functions.

Venous plexus in the Otter.

An essential purpose is served by a venous plexus in some *amphibious animals*. In the otter, the subcutaneous veins are very numerous: when it is under water, these veins serve as a *diverticulum sanguinis*, and become congested with that blood which cannot circulate through the lungs. But when the animal emerges from the water, and the air-cells are again distended, the blood then circulates freely through the pulmonary capillaries.

Venous plexus in other animals.

I have already endeavoured to show that the *vascular plexus* in the thorax of those *cetaceous animals* who dwell in great depths of the ocean, is intended as a reservoir, or *diverticulum sanguinis*, to receive the additional quantity of blood which is driven into the interior of the body when the animal descends deep into the water, from the great pressure of the superincumbent medium, and thus the hurtful effects of any congestion of blood in the vital organs is guarded against.

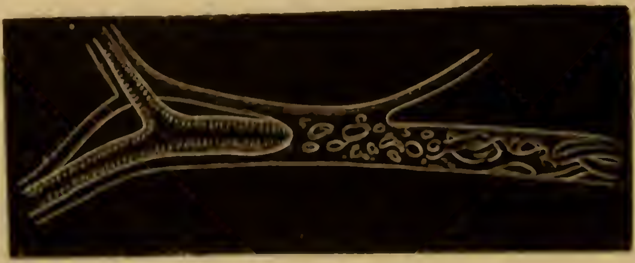

Fig 22

W. Vrolik.

In the same manner, the venous plexus, which has been lately discovered, though no explanation is offered of its functions, by a Dutch anatomist, in the *wings* of the *eagle* (fig. 22), *hawk*; and those birds who ascend many thousand feet above the surface of the earth, to me appears to be intended to act as a *diverticulum*, and to receive that extra quantity of blood which, by the pressure of the atmosphere, is driven to the interior of the body when the bird *descends* from a rare into a more dense medium. Thus we have a beautiful example in the animal economy employing the same physical apparatus, the same organization, to fulfil a similar purpose in two very different races of living beings.

The explanation now offered of the office of the vascular plexus in the wings of some birds, and in the thorax of cetaceous fishes, receives additional confirmation, when we consider the important aid which such plexus will serve in each of these tribes of animals, materially assisting them to provide themselves with that particular food intended for their consumption. Thus it enables the *whale* when, from a vast depth, he discovers a shoal of those small fish upon which he subsists, to *ascend* to the surface of the ocean with wonderful rapidity, and with his enormous mouth, to catch them in myriads; and it enables the *eagle* rapidly to *descend* from a vast height to the surface of the earth, and pounce upon his prey.[1]

The Subcutaneous Veins.—Besides these peculiarities of the venous system which have been mentioned, there are arrangements in the veins of some organs the particular office of which have never been satisfactorily explained. Of these there are remarkable examples in the *subcutaneous* and *intermuscular* veins.

The *subcutaneous* veins of the lower extremities are placed externally to the muscles, immediately above the fasciæ, and have numerous valves. Besides conveying the blood to the right heart, these veins perform an important function connected with the pulmonary circulation, acting as a *diverticulum*, by receiving whatever venous blood the pulmonic heart cannot contain. Thus whenever there has been any great muscular exertion, or, when in disease, the venous blood within the heart is congested, the current of the blood in the pulmonary vessels is retarded, and the venous blood is driven with great velocity forwards into the right auricle, its regurgitation being prevented by the valves:

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[1] "The Italians compare the violent descent of the sea-eagle on their prey to the fall of lead into water, and call them *aquila piombina*, or the 'Leaden Eagle.'"—Goldsmith's *Animated Nature*

the veins then become swollen, and remain gorged with blood until the thoracic viscera are able to receive and circulate the accumulated venous blood. This venous congestion from violent muscular exertion, is remarkable in some animals that have great speed, as in the *horse*, the subcutaneous veins in that animal being enormously distended after a great muscular exertion.

The Intermuscular Veins.—The intermuscular veins of the extremities, the *venæ comites*, are enclosed in a sheath along with the arteries, and, unlike the subcutaneous veins, they have no valves, and are placed in such relation to the muscles, that they are completely under the influence of their contractions.

I have already mentioned different arrangements, which the economy has employed, to prevent some arteries being pressed upon by the adjacent muscles, during their contraction, whilst others are so placed, that the current of their blood is more or less obstructed, when the adjacent muscles contract.

There is the same arrangement in the venous system of the extremities, the subcutaneous veins being situated externally to the fasciæ, so that the circulation in them is not interrupted by the muscular contraction, whereas the circulation, in the intermuscular veins, is impeded by every action of the muscles of the limbs.

Veins of the cerebro-spinal system.

The veins of the *brain and spinal chord* exhibit peculiarities in their structure and arrangements no less remarkable, and of no less pathological importance, than those of the cerebral arteries; and the symptoms in disorders of the heart, which are manifested by changes in the venous circulation of the nervous system, form a class of no inconsiderable value.

Whilst various contrivances are employed to secure to the cerebro-spinal system, at all times, a due quantity of *arterial* blood, there are means equally ingenious for securing a free transit of the *venous* blood, thus warding off the evil effects of an over-distention in the sanguiferous system of the brain and spinal chord.

The number of the veins of the brain and spinal chord is infinitely greater than that of the arteries. They have innumerable *anastomoses;* and, like the veins of the lungs, liver, and kidneys, they have no valves; neither do they accompany the

The interosseous veins.

arteries, nor have their principal trunks the common structure of other veins. The firm unyielding walls of the *sinuses*, and the vast number of veins which modern anatomists have discovered embedded in the *diploe* of the bones of the cranium (fig. 23) and vertebral column, are striking peculiarities in the character of the veins of the cerebro-spinal system.

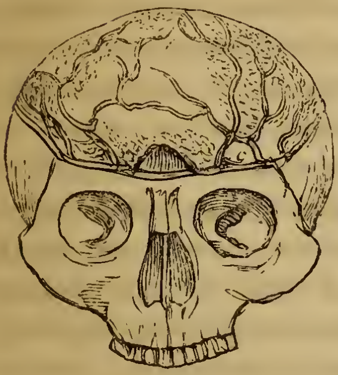

Fig 23.

All these peculiarities in the structure and arrangement of the venous system of the brain and spinal chord must, undoubtedly, have some essential offices to perform in the circulation. The great number of the veins, the freedom with which they anastomose, the unyielding walls of the sinuses, and their passage through the middle of the bones, must afford ample means for the blood, under all circumstances, to escape from the head; and, as was observed by Haller, "no violent symptoms follow upon tying a vein, however large, or even both the jugular veins." Hence it appears that whilst the most ample means are taken to secure to the cerebro-spinal system a due quantity of arterial blood, an extraordinary facility is, likewise, afforded to aid the return of the venous blood.

Office of the Dura Mater.

Besides the peculiarities in the structure, and in the arrangement of the cerebral arteries and veins, the prolongations of the *dura mater* ought likewise to be taken into consideration. These prolongations are calculated to prevent one portion of the brain pressing upon another, in the various positions of the body, and likewise from compressing one another when the brain happens to receive any concussion: it is to avert such accidents that the cerebrum and cerebellum in the swiftest quadrupeds are separated from each other by a bony partition. This subdivision of the brain seems, indeed, to be intended for a similar purpose, as that which is found in the testis; the delicate structure of that gland being subdivided by processes of the *tunica albuginea*, by which the different lobules are prevented from pressing on one another in its varied positions.

Peculiarities in the veins of animals.

Besides these varieties in the arrangements of the veins, there are peculiarities in the abdominal, portal, and fœtal venous systems. Peculiarities are also observed in the venous system in some of the inferior animals. In the Phocæ, Sabatier found a "great dilatation of the inferior cava, at the place where it arrives at the posterior surface of the liver, forming a receptaculum to receive the blood when the animal plunges into the water."

Ganglionic system—its circulation.

I need say little, as regards the circulation of the blood in the *ganglionic* system, for, however complete that system may in itself be, as regards the disposition of its nerves, yet, as the nerves which form it are all connected with the *cerebro-spinal* system, they will be influenced by those modifications in the circulation which influence the brain and spinal chord. So that we are led to the important conclusion, that the circulation of the blood in the great nervous centres is in all of them regulated and modified by the same causes.

Recapitulation.

Recapitulation

On reviewing all these peculiarities in the circulation of the blood in the *cerebro-spinal* system, there are several points in the anatomy to which I have alluded that may be briefly recapitulated; these being equally interesting to the physiologist as they are important, in affording a satisfactory explanation of many of the symptoms in diseases of the heart, and of the cause of many disorders of the nervous system.

1*stly*, We have seen that the brain and spinal chord are supplied with a larger quantity of blood than other parts of the body of an equal bulk.

2*ndly*, That the cerebro-spinal system is supplied with blood by the internal carotid and vertebral arteries; that the two carotids are larger in their calibre than the vertebrals, and supply the greatest proportion of the blood.

3*rdly*, That the circulation of the blood in the vertebrals is much less liable to interruption than in the carotids; special means being resorted to for securing the free passage of the blood from the heart to the brain, by osseous canals provided for the transit of the vertebral arteries.

4*thly*, That, as both the brain and spinal chord are supplied with blood by the same channels, the whole nervous system may be simultaneously influenced by changes in the action of the heart.

5thly, That a regular and equal circulation in the nervous centres is secured, not only, by a free inosculation between the internal carotid and vertebral arteries, but also by the trunks of the two vertebral arteries joining together, on entering the cranium, and afterwards subdividing.

6thly, That the brain and spinal chord are not only supplied with the blood both of the vertebral and internal carotid arteries, but these vessels freely anastomose with the arteries of the external parts of the head and trunk—which anastomosis further secures a regular supply of blood to the whole cerebro-spinal system.

7thly, That the two spinal arteries are formed by branches from each vertebral trunk, thus securing the equal distribution of the blood in the spinal chord.

8thly, That the tortuous course, both of the vertebral and internal carotid arteries, before entering the head, prevents any disturbance of the circulation when the head is in a dependent position, by taking off the weight of the superincumbent column of the blood.

9thly, That as the different portions of the brain and spinal chord are supplied, each by branches of different arterial trunks, the symptoms which accompany diseases of the heart will differ, according as the circulation is changed in the one or other of the cerebral arteries.

10thly, and *lastly*, That the veins of the brain and spinal chord, like the arteries, are so placed and constructed that no external causes can prevent them from duly performing their functions.

CHAPTER III.

THE MUSCULO-CARDIAC FUNCTION.

The musculo-cardiac function explained; some organs perform several different functions; influence of muscles on the circulation; they accelerate the return of the venous, and impede the exit of the arterial blood; some muscles employed to compress arteries; *some arteries are exposed to, and others protected from, muscular pressure; why veins accompany only some arteries; influence of muscular contractions on the* vasa propria *of muscles.*

The simplicity of Nature's works.

However difficult it may have been to explain satisfactorily any of the phenomena of the animal creation, yet, whenever a step has been gained in physiological science, we are struck with the remarkable simplicity of the means which Nature employs for accomplishing what to us had appeared a most complicated function in the economy. When endeavouring, therefore, to explain any of those phenomena of living beings which have hitherto evaded research, it may be anticipated that, if our inquiries should be successful, they will not lead to the discovery of *new* laws, but unfold the same wonderful simplicity of means for performing the operations of the economy, as has already been revealed by human intellect. It has, indeed, been justly observed, in allusion to the progress of chemical science, that it has shown " from what a small store of primitive materials have all that we behold and wonder at, been created!" Thus, as physiology has advanced, and that we have been able to explain many of the phenomena of living animals, the laws which govern them are found to be few and simple; so that it is by no means improbable that some such general law as that of *gravitation*,

Chenevix

which governs inanimate matter, may yet be discovered, governing and regulating all the phenomena of organized beings!

> "Magnificence divine;
> Oh! wisdom truly perfect! Thus to call
> From a few causes such a scheme of things;
> Effects so various, beautiful and great!"
>
> Thomson.

Some organs perform several functions,—

In the arrangements of the animal economy, it may be frequently observed that one organ is destined to perform several distinct functions—functions, indeed, in some instances so dissimilar and apparently so unconnected with each other, that it could not be well anticipated, they could be executed by the same physical apparatus.

as those of mastication,

Thus, for example, the *muscles of the jaw* are not only employed to masticate the food, but they, at the same time, and by the same muscular effort, evacuate the salivary glands, squeezing the saliva into the mouth by the pressure which they produce during their contractions on the salivary apparatus.

(The lacrymal organs)

The *orbicular muscles* are not only employed to move the eyelids over the eyeball, to protect it from light and extraneous substances, but they also compress the lacrymal gland, and thus increase the flow of tears in the act of weeping: and "when a greater quantity of tears is wanted, we contract the forehead, bring down the eyebrows, and use many other distortions of the face to compress the lacrymal glands, and increase the flow of tears."

(Darwin's Zoonomia)

and those of urine,

The *urinary organs* of the male, moreover, are employed for the transmission of the seminal fluid, as well as to afford a passage for the urine; and *the bones* not only support the body like a framework, but they afford fixed points for the origin and insertion of the various muscles, and they also form walls of defence for the internal organs,—the brain, the thoracic and the pelvic viscera.

and the bones,

and the organs of respiration,

The functions of the *respiratory apparatus* are still more multiplied. Besides oxygenating the blood, conveying odorous substances through the nasal passages to the organ of smell, assisting the return of the venous blood to, and the exit of the systemic blood from the heart, and producing the voice, they are also, as I shall demonstrate, employed in modifying the supply of blood to the heart. In birds, the functions of the respiratory apparatus are even more numerous, the air passing into membraneous sacs within the chest and abdomen, as well as into their hollow bones, in order to assist their flight.

and the muscles.

In like manner, I shall endeavour to show that the *muscles*, besides being the organs of active motion, destined to perform the various movements of the body, are essential auxiliaries in the circulation of the blood, in the *arteries* as well as in the veins, performing both these offices merely by the *pressure* which they produce during their contractions upon the adjacent blood-vessels. And further, it will appear that when such muscular efforts are required, an additional vigour being at the same moment wanted for the heart, this office is performed by the contractions of the same muscles, which are employed to accomplish the effort: and thus it is wisely constituted that the very identical organs which perform the movements, and necessarily cause a certain degree of exhaustion, should also be the means of invigorating the heart itself, and thus enable the muscles to continue their exertions.

The muscles aid the systemic circulation.

A general view of the means by which the circulation of the blood is carried on throughout the animal creation, as well as the phenomena of diseases, will serve to point out the errors of those physiologists who have endeavoured to explain the *systemic* circulation by the action of the heart alone. The momentary flushings of the cheek, and the diseased changes in the cutaneous capillaries of a common pustule, might have been deemed sufficient to show that these vessels are endowed with powers and perform functions in the circulation which are independent of the central organ. The fact that the circulation of the blood is carried on in some of the lower animals, as in *worms*, which are without a heart, only by the almost incessant motions of their bodies, might surely have indicated that muscular contractions must have at least *some* influence on the circulation of the blood in the arteries as well as in the veins.

Evidence derived from comparative anatomy.

So important, indeed, is the influence which the muscular contractions have on the circulation of the arterial blood, that in various tribes of animals the heart is found developed more and more perfectly in proportion as the animal is less exposed to motion. Hence, whilst the restless *insect* requires no heart to impel its blood, the *shellfish*, fixed and motionless on its rock, is provided with a central organ or heart, to carry on the circulation. In man the office required of the heart must therefore vary considerably with his bodily pursuits, the sedentary habits of some preventing it from deriving little or any assistance from the organs of locomotion, whilst the active occupation of others materially aid the circulation of the blood.

Muscles accelerate the return of the venous blood.

When the respiratory apparatus is healthy, and the circulation through the right heart undisturbed, the pulmonary veins afford a sufficient supply of oxygenated blood to the left heart, for the ordinary purposes of the systemic circulation. During sleep this must be strictly true; but if the heart be suddenly required to act with an additional vigour—a circumstance which is frequently taking place whilst we are awake—an increased supply of blood then becomes necessary, the energy of the heart depending on the quantity of blood with which it is supplied. This important office we shall find is fulfilled, not only by accelerating the flow of the venous blood into the right heart, but also by *impeding* the exit of the arterial blood from the left heart: both which purposes are admirably effected simply by the change of form which muscles undergo during their contractions.

That the velocity of the circulation in the *intermuscular veins* of the extremities is accelerated by the contraction of the muscles of the limbs, and consequently that muscular exertions assist in propelling the venous blood towards the right heart, is a fact that has been long since pointed out, and generally admitted by physiologists. This influence of muscular contraction on the veins was considered by Haller, and never contradicted by subsequent writers, as alone sufficient to explain both the increase in the heart's action, and the frequency of respiration which follow muscular exertions.

Muscles impede the exit of the arterial blood.

But whilst it was demonstrated that the pressure caused by muscles, during their contraction, propels the blood onwards in the contiguous veins to the right heart, it seems never to have been contemplated what must be the effect of that same compression on the adjacent *arteries*, although these vessels are doubtless alike exposed to its influence. In the subsequent researches I will endeavour to demonstrate, that the organs of active motion perform a most essential office in the circulation of the blood in the arteries, as well as in the veins; and that muscular contractions on the arteries adjacent to, as well as on those imbedded in the substance of muscles, must compress these vessels, by which the flow of blood through them will be more or less impeded: so that it will appear that the contraction of muscles increases the accumulation of blood within the heart in two ways—by *accelerating* the flow of the venous blood to the right heart, and by *impeding* the exit of the arterial blood from the left heart.

If, therefore, by the contractions of muscles, the free passage of the blood be impeded in any particular arteries, such as in those imbedded in the muscles of the limbs, there must take place a corresponding obstruction to the exit of the arterial blood from the left ventricle, and consequently an increased impetus given to the blood in those arteries whose branches are not compressed. In estimating the legitimacy of this conclusion, it ought to be borne in mind, that all the arterial tubes are so completely filled with blood, as to constitute, as it were, a solid yielding column; and consequently a pressure, however slight, made upon one part of that column, must be instantly felt throughout the whole arterial system.

Hyslop's observations,

Mr. Hyslop, having bled a lady to syncope, became alarmed at its long continuance; and, on accidentally raising her from the horizontal position, firmly grasping her arms and supporting by them the weight of the body, she rapidly recovered. Surprised at this, more particularly as the change from the horizontal to the erect posture might have been expected to have an opposite effect, he was led to reflect what could be the cause of so sudden a restoration of the heart's action; and he became convinced that, whilst elevating the body, and allowing its weight to be supported on that part of the arms along which the brachial arteries pass, he must have compressed those vessels, the effect of which compression would be an impediment to the flow of blood through them, and consequently an increase in the quantity of blood in the heart. He thence concluded that the rapid recovery of this patient from syncope was analogous to the artificial process of transfusing blood. Subsequent experiments enabled him to prove the accuracy of this observation. He found that by the application of a torniquet on the brachial artery, he could increase the heart's action about ten pulsations in five minutes,

and his experiments.

—an ingenious mode, which he afterwards proposed to adopt in order to revive the heart in cases of syncope or apparent drowning.

Additional illustrations.

This interesting observation leads not only to a satisfactory explanation of some phenomena of the circulation, but it proves how the quantity of *arterial* blood within the heart, and, consequently, the vigour of the heart's action, are increased by muscular exertions. It seems, indeed, remarkable that, although Parry, Kellie, and other ingenious men had employed artificial means for compressing arteries, in order to relieve some diseases, yet they never seemed to have contemplated what would be the effect of muscular contractions on the circulation of the adjacent arteries, and of their influence upon the circulation.

Muscles employed to compress arteries.

That muscular contractions compress arteries, and thus increase the action of the heart, by impeding the transit of the blood through them, may be demonstrated by experiment, as well as by various phenomena.

Proved by experiment.

If the radial artery of a person who is powerfully contracting the muscles of the hand and arm be examined, its pulsations are soon found to become feeble, and at last they are scarcely perceptible; whilst the moment the muscles are relaxed, the artery is perceived to beat with its natural force. By the same experiment it may also be shown, that the effect of impeding the transit of the blood in the arteries is to increase the action of the heart; for it will be found that, in proportion as the strength of the pulsations of the radial artery diminishes, so the impulse of the heart is increased.

Position of arteries in relation to muscles.

Next, let us consider the position of arteries in their relation to the muscles, and learn the mechanism which enables the muscles, on contracting, to compress the contiguous vessels in such a manner as to *impede* the flow of their blood.

For performing this important function of the circulation, and which I have denominated the *musculo-cardiac function*, we find several simple and beautiful contrivances; we also have a striking illustration of this peculiar office of the muscular system, comparing it in the mechanism which nature has employed in order to *prevent* the compression of some arteries, when their compression would be injurious to the performance of the functions of those organs which such arteries supply. Although it may not be requisite that every organ should be at all times supplied with the same quantity of blood, yet there are other organs in which any deficiency in the supply would be prejudicial, or even fatal, to the functions of life: whenever, therefore, the heart requires an additional quantity of blood, that office is fulfilled by impeding the flow of the arterial blood only, through the vessels of those organs, which do not at all times require a uniform supply of the vital fluid.

Some arteries exposed to, and some protected from, pressure.

Hence we find that the arteries of all organs of the first denomination, as the brachial and femoral arteries, are so placed, that they must inevitably be more or less compressed by the contractions of the adjacent muscles; whilst the arteries of other organs, as those of the brain, iris, alimentary canal, and coronary arteries of the heart, are so situated, that they are protected from all pressure arising from the contractions of those muscles that are contiguous to them.

Why veins accompany some arteries only;

There are, indeed, several points in the anatomy both of the muscles and of the arteries, which are specially subservient to the *musculo-cardiac* function. Arteries are found to accompany veins, where it is intended that *both* these systems of vessels shall be influenced at the same time by muscular contractions. Long as this relative position of the arteries and muscles of the limbs has been known to anatomists, yet no rational explanation of the purpose of this arrangement has ever been given. It is, however, evident, according to the preceding views, that, by such a disposition of the two systems of vessels, the velocity of the blood is equally influenced in the arteries, and in the veins whenever the adjacent muscles are contracted; and that, whilst muscular contractions assist in propelling the venous blood forwards to the right heart, the valves preventing its regurgitation, the same pressure must impede the current of the blood in the adjacent arteries, and thus diminish its exit from the left heart.

Here, then, we have anatomical facts affording additional evidence of the simplicity and infinite wisdom which the Creator displays in all his works, by employing one organ to perform at the same time more than one function. Thus, veins and arteries accompany each other in those situations, where it is intended that the circulation, both of the venous and arterial blood, shall be influenced by the contractions of the adjacent muscles, and those vessels which are *not* liable to compression from muscular contractions are not similarly disposed, either with relation to the muscles or to each other; hence in the internal viscera, as the brain, lungs, and liver, veins do not accompany the arteries.

As those of the extremities.

No arrangement could be better adapted for such compression than the course which is assigned to the femoral and brachial arteries: these enclosed in a sheath, with their *venæ comites*, being in some places completely encircled and imbedded in the large muscles of the extremities, so that on every movement of the limbs they must suffer more or less compression.

Fig. 24.

To exhibit this relative position of the arteries and muscles, we have only to examine a vertical section of the thigh. The arteries, with the accompanying veins, are seen enclosed in their sheaths, and surrounded by the muscles in such a manner that, when the limb is moved, and, consequently, these muscles contracted, their pressure upon the arteries must necessarily impede the passage of the blood.

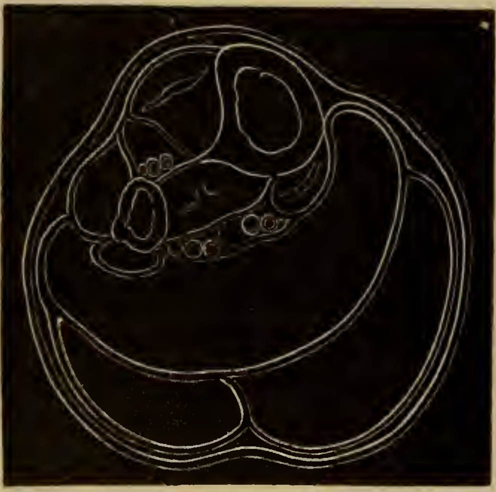

Fig. 24.

Influence of the involuntary muscles on the circulation.

The effects of the contractions of the muscles of the extremities, in compressing the brachial and femoral arteries, will suffice to point out all that is here requisite to be noticed as regards the influence of the *voluntary* muscles in increasing the vigour of the heart; and it will also be found that the *involuntary* muscles perform an equally important share in modifying the circulation of the arterial blood.

It has been already shown that the arteries which supply the heart, and likewise those of the stomach, lips, and iris, are so placed, that the circulation in them can never be interrupted by the movements of these organs. Neither are the vertebral arteries, nor those of the lungs, subject to pressure from the contractions of any of the voluntary, or of the involuntary muscles; the *anastomosis*, and the protection which is afforded to the cerebral arteries, warding off the influence of any movements of the neck, and the pulmonary vessels are affected only indirectly by the motions of the parietes of the chest.

Influence of the peristaltic motion of the alimentary canal.

On examining the alimentary canal, we there find an illustration of the function which is performed by the contraction of *involuntary* muscles on the circulation. The vermicular motions of the stomach, and intestines during the process of digestion, must, doubtless, have a very considerable influence on the circulation of the blood, both in the veins and in the arteries of these organs; so that during the peristaltic movements of the alimentary canal, there is an increase both in the impulse of the heart, and in the frequency of the arterial pulse. In this respect, the circulation of the blood in the intestinal canal, in part resembles that which exists in *worms*, the almost unceasing movements of these animals being sufficient, as has been previously noticed, to circulate their blood, unaided by a heart.

Page 64.

Effects of muscular contractions on the *vasa propria*.

Besides the influence of muscles, during their contractions, in compressing the adjacent arteries, it is quite evident that they must also compress those vessels which are distributed in the muscular tissue itself—the *vasa propria*, and thus diminish the circulation through them. This circumstance satisfactorily explains an observation made by the elder anatomists,—that when a muscle is exposed in a living animal, the red colour diminishes in intensity during its contractions, and returns when the muscle is relaxed.

How some arteries are protected from muscular compression;

Whilst investigating the phenomena of the *musculo-cardiac* function, it is interesting to examine not only Nature's contrivances, in order to *impede* the flow of blood through the arteries, when she requires an increase in the quantity of the vital fluid in the heart; it is no less instructive to observe the means which are employed to prevent muscles from compressing the arteries and veins of those organs, the functions of which would be disturbed by any interruption to their regular supply of blood.

In those arrangements where the compression of arteries from the contractions of muscles is to be avoided, I have remarked, that either circles of *anastomosis* are established between different arterial trunks, or that the vessels themselves are so placed that they are completely *protected* from all that pressure to which they would otherwise be exposed by the contractions of the adjacent muscles.

by anastomosis;

Of the first of these provisions we have examples in the anastomosis of the coronary arteries of the *heart*, the *stomach*, the *intestinal canal*, *hands*, and *lips*, and in the circles of anastomosis of the arteries of the *iris;* the effect of all which free inosculations is obviously intended to render any obstruction in the arterial circulation of these organs impossible; a circumstance which would be constantly taking place from their unceasing movements, had not such anastomosis been established.

(See page 40)

(See fig. 11)

Each of the two ciliary arteries of the iris divide into two branches, which afterwards reunite, encircling the interior of the globe of the eye. From this arterial circle numerous branches go off at right angles, and are distributed upon the iris; all these branches anastomose with one another, and form a circle round the pupillary opening. Thus, notwithstanding the varied and constant movements of the iris, every part of it is uninterruptedly supplied with blood.

by peculiarities in their course.

The other provision to which I have alluded, or where arteries are protected from any compression by the contractions of the adjacent muscles, is exemplified both in the *heart* and in the *brain.*

Course of the coronaries.

See page 40.

In order to prevent any interruption to the circulation in the vessels destined to supply the heart, there is not only a free anastomosis between the *coronary arteries*, but also a peculiarity of structure, already mentioned; both arteries and veins passing along a tendinous furrow or groove, between the auricles and ventricles, in such a manner that, during the unceasing contractions and relaxations of the muscles of these cavities, the circulation of the blood, neither through the veins nor arteries, can ever be interrupted.

And again, if we look at the *vertebral arteries*, we find that

Course of the vertebral arteries.

these vessels are also protected from muscular compression, independently of having a free anastomosis established between them within the cranium. These arteries pass along the bony canals of the cervical vertebræ, by which they are so protected, that the current of the blood in them can never, like that in the carotids, be interrupted by any pressure from the contractions of the muscles of the neck, and during the varied positions of the head. Anatomists have assigned a very different use of this bony canal, attributing to it the office of merely protecting the artery from external injury, or preventing any increase in its size.

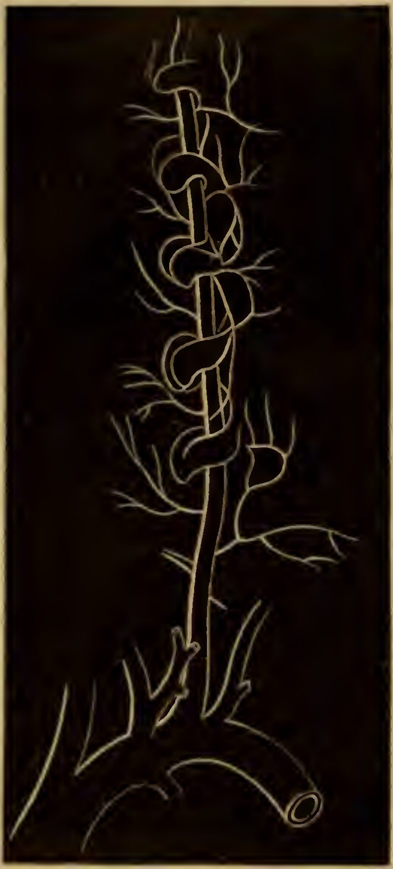

Fig. 25.

Indeed, had there not been such a distribution of the arteries of the brain, and if the vertebral arteries, like the carotids, had been constantly exposed to compression from the contractions of the muscles of the neck, and also from alterations in the position of the head,—or if there were no free communication between the vertebrals and carotids, then the proportion of arterial blood within the head would have been exposed to constant variations, and the functions of the brain liable to incessant disturbance,—accidents which the mechanism now described is admirably calculated to avert.

Course of the aorta femoral, popliteal, and arteries of the hand.

Some arteries, I have already mentioned, are protected from muscular pressure by passing through a *tendinous ring.* The aorta passes through the diaphragm—the femoral artery perforates the abductor muscle; the popliteal artery goes through the head of the soleus muscle; and the arteries of the hand pass through the tendinous aponeurosis of the wrist.

Illustrated in some animals

In further corroboration of the purposes which are served by peculiarities in the course of some arteries, it is interesting to notice the ingenious mechanism in the vascular system of certain organs of the lower *animals*, all which are evidently intended to guard arteries against any compression from the contractions of the adjacent muscles, under circumstances when such pressure would be injurious.

In the feline tribe;

Thus, in the *lion*, the arteries of the head are so distributed, that the muscles of the jaws can be for a long time kept in a state of powerful contraction when holding his prey, without the circulation being interrupted.

in the *bradypus tardigradus*;

In the tardigrade animals, as the *sloth*, there are no less than two distinct provisions in the arrangement of the brachial arteries, evidently intended to prevent the circulation from any interruption by the long-protracted muscular contractions to which the limbs of these animals are exposed in climbing, or in grasping their prey. Besides that peculiarity of structure in the feline tribe, which I have mentioned, where the artery is guarded from compression by passing through a foramen in the humerus, the brachial artery of the sloth (see fig. 16) divides into numerous parallel branches, which afterwards reunite in one trunk; so that when this creature is suspending itself on a tree, or grasping its prey, which it often holds uninterruptedly, for many hours, the long-continued contraction of the muscles of the limbs cannot impede the circulation of the blood in the remote branches of the brachial artery. Langstaff found it difficult to separate the branches composing this brachial plexus; but from the dissections which he made, he was disposed to believe that, besides forming a plexus, the trunk of the artery itself is continued through the middle of the plexus, so that, for the common purposes of life, the circulation can go on solely in the trunk of the vessel. This singular distribution in the brachial artery of the sloth was first described by Carlisle, who conceived it to be the cause of the slowness of its motion.[1]

(See fig. 16)

(See Carlisle, in the Phil. Trans. 1084)

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[1] The sloth, of all animals, is the most sluggish and inactive; and, to judge from outward appearance, it would seem the most helpless and wretched. All its motions seem to be the effect of the most painful exertion, which hunger alone is capable of exciting. It lives chiefly in trees; and having ascended one with infinite labour and difficulty, it remains there till it has entirely stripped it of all its verdure, sparing neither fruit, blossom, nor leaf; after which it is said to devour even the bark. Being unable to descend, it throws itself on the ground, and continues at the bottom of the tree till hunger again compels it to renew it toils in search of subsistence.

Its motions are accompanied with a most piteous and lamentable cry, which terrifies in the aorta of fishes;

For a like purpose I have mentioned the peculiarity in the course of the aorta in some fishes. After having supplied the abdominal viscera, that vessel in the *shark* passes along a channel formed by the bony processes of the vertebræ, so that the circulation can never be disturbed in the powerfully muscular tail during any of its movements.

in birds and in monkeys.

The same arrangement is also remarkable in the long flexible necks of *birds*. In the tail of the prehensile *monkeys*, the continuation of the aorta is protected from pressure by the inferior rings of the vertebræ, whilst there are also very numerous inosculations of the arteries of the tail.

Fig. 9, p. 39.

Here, then, as well as in the human brain and heart, are examples of arteries passing along a course, by which they are completely protected from all muscular pressure; whilst, on the other hand, other arteries are so placed in relation to muscles, that they are subjected to muscular compression in order to fulfil a very important function in the animal economy.

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even beasts of prey, and proves its best defence.

Though slow, awkward, and almost incapable of motion, the sloth is strong, remarkably tenacious of life, and capable of enduring a long abstinence from food. We are told of one that, having fastened itself by its feet to a pole, remained in that situation forty days without the least sustenance. The strength in its legs and feet is so great, that, having seized anything, it is almost impossible to oblige it to quit its hold. The same animal laid hold of a dog that was set loose upon it, and held him fast with its feet till he perished with hunger.—Bewick's *History of Quadrupeds*, 457.

CHAPTER IV.

PHENOMENA DEPENDING ON THE MUSCULO-CARDIAC FUNCTION.

These phenomena explained; those on awaking from, and those which precede sleep; those before running or leaping; preparing to endure pain; on recovering from syncope; effects of bodily exercises explained—walking, driving, riding, and dancing; effects of gestures in public speaking. Influence of the musculo-cardiac function in diseases—in chosea, in tetanus, and in convulsions.

I SHALL now proceed to show that the *musculo-cardiac function* enables us to account for many important phenomena, which are constantly taking place in the living body, and which could not have been explained, until a knowledge of this function of the muscles had been discovered.

Some muscular movement will be observed to precede every effort which is made to increase the vigour of particular organs, because, for such a purpose, it is first required that the vigour of the heart itself should be increased. We therefore find, that, unless when the body is in a state of perfect tranquillity, which can scarcely ever happen but during sleep, the circulation of the blood in the different organs is constantly varying, any muscular movement, however slight, increasing the influx of the venous blood, and at the same time impeding the exit of the arterial blood from the heart. Thus, in some organs, the quantity of blood is diminished, and in others increased, by every motion of the body; those organs which are called upon to perform particular functions receiving an increase, whilst those, whose office is less urgent, experience a diminution, in the supply of the vital fluid.

It is, indeed, interesting to contemplate the beautiful contrivances which are employed by the animal economy, in order to fulfil this important office in the various organs, and to observe the injurious effects which result from deviations in the due execution of the circulating apparatus.

Phenomena of sleep explained.

No more satisfactory illustration need be given of the function of the muscles in modifying the circulation of the blood—the *musculo-cardiac* function, than by observing the development of those phenomena, and by reviewing the various functions successively, as they are evolved, in a person waking from sleep, and when passing from sleep to wakefulness.

The first indication of a person passing from sleep to waking is some movement of the body. The posture in which he had reclined is changed; and almost at the same moment, and just when becoming conscious of existence, the muscles of the extremities are contracted; the limbs are stretched, he yawns, and, finally, the intellectual powers awake.

The phenomena, which precede both sleep and wakefulness, are so uniform, and are so universal throughout the animal creation, that it would be unphilosophical to suppose they were not the effect of a fixed law of the economy, hitherto undiscovered, and that they could not be reasonably conceived to be the result of chance, or the effect of habit.

All these muscular movements can be satisfactorily explained by contemplating the effects on the circulation, which, as I have endeavoured to demonstrate, are produced by muscular contractions on the adjacent arteries,—by the musculo-cardiac function.

The almost instantaneous effect of a person stretching the limbs whilst awaking from slumber, is rousing the powers of the mind; this is caused by an accumulation of blood in the heart, which such motions necessarily create, and which, by increasing its vigour, enables it to propel an additional quantity of blood to the head.

Scarcely has a man awoke, and the brain received this additional quantity of the systemic blood, before the mental powers are resuscitated; and, having now been refreshed by "balmy sleep," they almost immediately resume their wonted vigour.

The powers of the mind having revived, man is now fitted for his varied avocations, in the exercise of which the *musculo-cardiac* function continues to perform an important share.

The phenomena to be observed before a person falls asleep, Phenomena which precede sleep.

form a striking contrast to those which take place, when he awakes from slumber; these phenomena afford at least a negative proof of the influence of this function of the muscles.

On the approach of sleep, instead of making any muscular movement, a man prepares himself by seeking that posture which will relax the greatest possible number of the organs of active motion. He reclines in a horizontal posture, and places the limbs in a state of semi-flexion,—these preparations have the effect of tranquillizing the circulation, and of equalizing the supply of blood to every part of the body, so that the vigour of all the organs is diminished, and no one is more excited than another.

The habits and avocations of mankind afford ample illustrations of the large share which the *musculo-cardiac* function contributes in carrying on the circulation of the blood.

Phenomena which precede muscular exertions explained;

Observe how the strength and vigour of the body are increased when we require to make any great exertion, and how accurately this office of the muscles, unnoticed by physiologists, has been described by the immortal poet :—

> " Stiffen the sinews; summon up the blood;
> Now set the teeth, and stretch the nostrils wide;
> Hold hard the breath, and bend up every spirit
> To his full height." (Shakspere)

In order to produce a temporary increase in the heart's action, I have already remarked, that it is requisite to give to that organ an additional stimulus, which is at once effected by contracting such muscles as will compress the contiguous arteries, and thus impede the transit of their blood.

those made before running or leaping;

If, by way of illustration, a man be about to make any great exertion, such as *running* or *leaping*, he prepares himself by first vigorously contracting the muscles of the arms and clenching his hands. And in walking quickly, such as may be observed when a person is walking a match, he not only clenches the fists, but contracts the muscles of the arm, and keeps the arms firmly in close contact with the trunk of the body.

" A man leapeth better with weights in his hands than without. The cause is for that the weight, if it be proportionable, strengtheneth the sinews by contracting them. Otherwise, when no contraction is necessary, the weight hindereth. As we

(Bacon)

see in race-horses, men are curious to foresee that there be not the least weight upon the one horse more than upon the other."

preparing to endure pain;

For the same reason, when a person is subjected to bodily pain, he prepares himself to endure it, by throwing into action almost all the voluntary muscles, grasping firmly with his hands, pressing his feet against some resisting body, and clenching his teeth. All animals attempt to bite when they are suffering pain.

and during parturition;

So likewise, when a woman, during parturition, is about to make a powerful expulsive effort to assist the uterus in giving birth to the infant, she throws into violent and long-continued contractions the muscles of the extremities, clenches the jaws, and squeezes, with a convulsive effort, whatever may be within her reach.

and in disease;

Muscular exertions are also employed to effect a similar purpose in those, who, from disease in the urinary passages or rectum, have great difficulty in voiding their contents. Before endeavouring to accomplish such evacuations, they forcibly contract some of the voluntary muscles,—muscles whose actions are totally unconnected with those actions which are employed to perform the evacuations.

and in recovering from syncope.

No less remarkable is the influence of the *musculo-cardiac* function on those who are recovering from a state of *syncope*. Having passed into a condition, where the last spark of life had been apparently extinguished, the first symptoms of recovery from fainting are ushered in by a series of convulsive movements. Long-protracted inspirations are succeeded by powerful expirations, the limbs are convulsed, and the intellectual powers are gradually resuscitated.

The effects of bodily exercises explained.

The influence of muscular contractions, by increasing the vigour of the heart, explains, in a very satisfactory manner, the salutary effects, which children derive from their almost constant movements, and from all kinds of bodily *exercise*. How much, for instance, a person, when he feels sluggish and inert after mental fatigue, or from want of sufficient exercise, is revived and invigorated by *walking*. It also accounts for the exhilarating influence of *driving* rapidly in a carriage, and explains the "intoxicating effects" which "are experienced while galloping across the boundless desert."[1]

Walking, driving, and riding;

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[1] "A young French renegade confessed to Chateaubriand that he never found himself alone galloping in the desert without a sensation approaching to rapture which was inconceivable."—BYRON.

No less remarkable are the exhilarating effects of *dancing*,—so much so, that it has even been said to cure the bite of the tarantula. At a large manufactory at Lanark, where many children were employed, the best effects resulted from making them begin the day of toil and labour with a cheerful dance. The dance, indeed, seems to be common to mankind in all stages of civilisation, and its exhilarating influence universally acknowledged, not only by the young and the gay, but sometimes even by those far advanced in life.

dancing:

Upon the *orator* this influence of muscular movements is no less striking.. His gestures keep pace with his mental excitement, and his gesticulations become more and more extravagant in proportion as he becomes impassionod ; the heart thus acquiring an increase in the quantity of its blood, and, consequently, the brain receiving a proportionately increased supply of the vital fluid.

of gestures in public speaking.

All these phenomena can be satisfactorily explained, now that we comprehend how muscles, by their contractions, increase the quantity of arterial blood in the heart ; it is, therefore, surprising that physiologists, when endeavouring to account for the beneficial influence of various exercises, though they were aware that such exercises increased the return of the *venous* blood to the central organ of the circulation, should not have advanced a step further, and considered what must be the effect of the contractions of muscles on those arteries which are adjacent to them.

My attention was directed to some of these phenomena, and to the physical explanation of them which has now been given, when attending a person who had frequent attacks of gout, and who had been before affected with an arthritic inflammation of the pericardium. After that illness he suffered from palpitations of the heart every morning, just at the moment when he awoke, but they continued only a few minutes. He was also in the habit of *yawning* and stretching his limbs, whilst in the act of awaking, and immediately afterwards he felt the palpitation. He further observed, when interrogated on this point, that, if he accidentally awoke during the night, and stretched himself, palpitation of the heart always ensued.

Influence of the musculo-cardiac function in diseases;

The effect of *yawning* and stretching the body in disturbing a diseased heart, I also observed in a person who had for many

of yawning;

years suffered from a disordered circulation, and who was recovering from a febrile illness, for the relief of which an antiphlogistic treatment had been pursued. When convalescent he had no uneasy feelings remaining, except a pain in the head, which came on every morning immediately after he awoke, but did not continue longer than about ten minutes. From the circumstance of this headache occurring only after he awoke, and from his stating that he was in the habit of yawning and forcibly stretching his limbs whilst he was awaking, it appeared to me probable that the increase of blood in the irritable heart, caused by those movements, produced the headache in the same manner as it had in the former instance caused palpitation.

of chorea:

The effects of the unceasing muscular movements in *chorea*, and the remarkable difference in the action of the heart during wakefulness and sleep, in those who are suffering from that disease, afford a most incontrovertible proof of the *musculo-cardiac* function. In a young woman, who was severely afflicted with chorea, the heart's beats were so frequent during wakefulness, that I found it quite impossible to count them; but when she was asleep, and had no involuntary action of the muscles, the pulse did not exceed eighty beats in a minute.

of tetanus;

What the effects of *tetanus* may be on the circulation I have had no opportunities of ascertaining; but, from the decided benefit that has in some instances been derived from blood-letting, there is good reason to believe, that the permanent contraction of the muscles, characteristic of that disease, must, by impeding more or less the circulation in the arteries, cause congestion in the organs of circulation.

of loss of blood;

The violent contractions of the muscles of animals dying from the loss of blood appears to be an effort made by the musculo-cardiac function to maintain life by increasing the blood in the heart.

of different postures of the body.

The influence of the *musculo-cardiac* function, likewise explains how there is such a remarkable difference in the number, as well as in the strength, of the heart's pulsations, according as the body is in the recumbent or in the erect posture,—a difference particularly striking in all invalids, and which must have led to the common practice of preserving a supine posture in the treatment of diseases. The difference in the pulse is, indeed, sometimes so considerable in the different positions of the body, that it is necessary, before being able to form a correct judgment of the state of the circulating system, to examine both the heart and the arterial pulse when the patient is in the recumbent, as well as when he is in the erect posture.

Many symptoms of diseases explained.

If, therefore, the influence of muscular contractions on the *arterial* circulation be established, not only are we enabled to give a rational explanation of many phenomena, which take place in the healthy state of the body, but a most important field is opened for pathological research. It explains the hurtful effects of severe bodily exertions in over-exciting the heart; it explains, also, the beneficial influence of bodily tranquillity in all those ailments wherein the circulation is hurried or disturbed; and it accounts for the frequency of some diseases of the heart, in two very opposite classes of persons,—in those whose avocations expose them to violent muscular efforts, and in those whose organs of circulation, from not taking much bodily exercise, obtain little or no assistance from the contractions of the muscles.

The various involuntary movements which accompany some diseases, such as those during convulsive, epileptic, and hysterical fits, the permanent muscular contractions in those afflicted with trismus, and the temporary movements in chorea, must all have a greater or less influence on the action of the heart, and, as has been already said, can only be explained by a reference to the *musculo-cardiac* function.

Difference in the vascular system of the two sexes.

In like manner we can account for those differences, so remarkable in the vascular system of the two sexes. As the circulation of the blood in woman, from her inactive habits, derives little assistance from muscular contractions, the *arteries* become more lax and capacious than those in man; whilst the *veins* of men are proportionably much larger than those of women, the venous circulation being greatly influenced by all those muscular exertions to which men are so much exposed. In proof of these differences in the vascular system of the two sexes, it is only necessary to compare the distended and tortuous veins of the arm of an artisan with the delicacy, and beauty of the cutaneous surface of a woman.

Recapitulation.

Recapitulation.

In concluding this important subject, it may be expedient briefly to recapitulate the anatomical and physiological facts, by which I have endeavoured to prove that muscles, besides being the organs of active motion, execute an important office in the circulation, by compressing, during their contractions, the adjacent arteries as well as veins :—

1*stly*, That in the arrangements of the animal economy, one organ frequently performs several different functions.

2*dly*, That the muscles by their contractions impede the transit of the blood through the arteries which are adjacent to them, whilst they increase the flow of the venous blood in the adjacent veins.

3*dly*, That if the muscles of the arm are kept for some time contracted, the radial pulse diminishes in force, and soon becomes imperceptible.

4*thly*, That only some arteries are exposed to the influence of muscular contractions, whilst there are other arteries protected from all muscular pressure.

5*thly*, That of those arteries, which are influenced by muscular contractions, we have examples in the upper and lower extremities; whilst the arteries of the brain, iris, alimentary canal, and the heart, are all protected from muscular pressure.

6*thly*, That the *musculo-cardiac* function enables us to explain many important phenomena, which are constantly taking place both in health and in disease.

7*thly*, That sleep and wakefulness afford incontrovertible evidence of this function of the muscles.

8*thly*, That the muscular movements, which are made by those who are about to make any powerful effort, compress the adjacent arteries, for the purpose of increasing the quantity of blood in the heart, and thus increasing its vigour.

9*thly*, That the involuntary actions of the muscles, which take place in disturbances in the circulation, are resorted to by the economy to modify and restore the functions of the heart.

CHAPTER V.

RECIPROCAL INFLUENCE OF THE HEART AND THE RESPIRATORY ORGANS.

Reciprocal influence of the heart and respiratory organs; influence of inspiration and expiration on the heart; their various modifications; heart's action changed by them; remarkable examples of.

Having noticed the power of the heart in propelling the blood,—the different modes by which the arteries regulate its distribution to the various organs,—the changes produced in the circulation by the capillaries and the veins; and having also pointed out how the supply of blood, both to the right and left heart, is modified by the *musculo-cardiac function*, we come next to consider the influence which the respiratory organs exercise on the heart, and the share which they have in carrying on the great function of the circulation of the blood.

The lungs execute two different functions.

The lungs perform functions, some of which are *chemical*, and others purely *mechanical*. They absorb from the atmosphere, and convey to the blood, elements which are necessary for the continuance of life, and they likewise separate from the blood some of its excrementitious ingredients; so that they are organs both of incretion and of excretion.

They act as a *receptaculum sanguinis.*

They also serve the purpose of a reservoir or *diverticulum sanguinis*, receiving all such blood, both venous and arterial, which the cavities of the heart are not capable to contain, whether from the stream of the venous blood being accelerated, or from the exit of the arterial blood being impeded.

Comparative velocity of the pulmonic and systemic blood.

The lungs are remarkable for the quantity of blood which they contain; and as an equal quantity of the vital fluid must pass through them, as through the rest of the body in the same time, Page 5.

in order that the quantity of blood which enters the heart should be equal to that which leaves it, the velocity of the blood in the lungs must be less than in other parts of the system. As, therefore, the heart must propel the whole mass of blood through the lungs, it is manifest that changes in the action of the heart must have a great influence on the pulmonary circulation; and for the same reason, changes in the pulmonary circulation must disturb the action of the heart. Thus it is, that in diseases of the heart, the changes which take place in respiration constitute an important class of symptoms in the heart's diseases.

Influence of inspiration.

By whatever powers the venous blood reaches the two cavæ veins, *inspiration*, or that movement which draws the air into the chest, assists in bringing the *venous* blood into the right heart. Inspiration also assists the circulation of the blood in the pulmonary arteries, the expansion of the lungs facilitating the ingress of the venous blood into the pulmonary arteries, and permitting the oxygenated blood to flow readily through the pulmonary veins.

Influence of expiration.

Whilst the entrance both of the air, and of the venous blood into the chest, are accelerated by *inspiration*, in like manner the air is expelled, and an additional impulse given to the stream of the arterial blood by *expiration*. The diminution in the capacity of the lungs, and the subsidence of the parietes of the chest and abdomen, which take place during expiration, aid by their pressure the transmission of the oxygenated blood from the lungs into the left heart, and also assist in propelling the blood from the left heart along the large arteries, whilst at the same time they impede the current of blood coming from the right ventricle into the pulmonary artery. Inspiration may be therefore considered as accessory to the *venous*, and expiration to the *arterial* circulation, the one aiding the heart like a sucking, and the other like a forcing pump.

Reciprocal influence of respiration and circulation.

Hence, too, the reciprocal influence and co-operation in these two great functions of animal life, and hence we are enabled to explain the use of various peculiarities in the structure both of the respiratory and circulating apparatus which are found in the different tribes of animals, which, as will be shown, are intended to regulate and modify the distribution of the blood throughout the system, according to the habits and necessities of the different races of organized beings.

Uses of their various modifications.

To effect a variety of purposes in the animal economy, modifications in the inspirations and expirations are constantly resorted to, sometimes the inspirations, and sometimes the expirations, being lengthened or shortened : by these modifications, changes are produced either in the quantity of blood within the heart, or in the velocity of the blood's stream. Thus the breathing may be observed to be changed in the acts of swinging, turning round rapidly, standing on the head, or when a person is on board a ship. Respiration is also modified in sobbing, sighing, weeping, yawning, laughing, crying, vomiting, and hiccup; all which acts, I will subsequently point out, are *instinctively* resorted to for the purpose of adjusting the circulation, when it has been disturbed, not only in health, but in disease.

How the heart's action is changed by respiration.

Such, indeed, is the influence of respiration on the action of the heart, that its movements can be even altered by a voluntary change in breathing: the ingenious experiments of Sir Benjamin Brodie have shown that, when an animal is decapitated, or the brain under the influence of poison, and the heart has even ceased to beat, its action may be restored by artificial breathing. Thus some persons, by making a very slow and long-protracted inspiration, are able to render the action of the heart so languid, that the pulse cannot be perceived at the wrist; whereas by very quick breathing, the action of the heart may be greatly accelerated.

Cases.

It is told of John Hunter, when suffering from a disease in the heart, that upon one occasion, on the approach of a fit of *syncope*, he recovered himself, and absolutely saved his life, by making a violent respiratory effort.

Case.

This influence of the respiratory organs on the action of the heart, was strikingly illustrated in the case of a lady, whose heart sometimes acted so irregularly, that she frequently fell into a state of syncope, and accidentally discovered that by the act of *singing* she could prevent herself from fainting. "I will write you," she observed, "something very remarkable about myself, namely, that when my heart is in a great flutter, and I am not certain whether I shall faint away, *singing* removes it almost directly. One Sunday, when in church, I expected, every moment, I should be obliged to be taken out, and disturb the congregation, when happily the psalms were beginning to be sung. I instantly joined in the psalm, and the comfort the act of singing then gave me was almost instantaneous."

Case.

A case, in many respects analogous, also points out the intimate association of the respiratory organs with the heart. A youth was subject to disturbances in the circulation, which often caused paroxysms of violent spasmodic movements in the muscles of the neck, face, and upper extremities: the singular circumstance was, that he could prevent the fit by repeating the Lord's Prayer in a subdued tone whenever he felt its approach.

Case.

Another remarkable instance of the influence of the respiratory organs on the action of the heart occurred in a young lady, who had suffered severely from a disordered heart caused by a sudden fright. When the disturbed circulation was relieved, she was instinctively impelled, and found great comfort from laughing and screaming violently.

Case.

A youth, with a congested heart, applied a small number of leeches on the cardiac region; after they had removed a moderate quantity of blood, he irresistibly began to laugh, and the laughter produced a feeling of so much relief, that he continued some time laughing.

"Every one knows," observes Bichat, "that the muscles of organic life are *involuntary*. If there are men who have the power of stopping the action of the heart, it is not upon that organ that the brain acts; the action of the diaphragm and intercostal muscles is then suspended, respiration momentarily ceases, and hence the circulation."

Bichat.

Whilst such modifications in respiration are in some instances the means of restoring a disturbed circulation, there are other modifications wherein changes of breathing *derange* the functions of the heart. Of this a striking instance occurred in a lady who had a very irritable heart, and who, when accidentally amusing herself with blowing some bird-seed, experienced so great a disturbance in the circulation as to cause a violent hysterical paroxysm.

Case.

Case.

The remarkable case of Colonel Townsend has been frequently referred to, in order to show the influence of the mind on the action of the heart: though the power which he possessed over it was evidently effected by changes in respiration. He could suspend life when he pleased, and, by an effort, he could restore it again! "Before making the experiment on the day of his death his pulse was distinct, though small and thready, and his heart had the usual beating. He composed himself and lay on his back in a still posture for some time. His pulse sank gradually, till at last it could not be felt by the nicest touch; not the least motion could be felt in the heart, nor the least soil of breath perceived on a bright mirror held to his mouth; not the least symptom of life could be perceived. He continued thus for half an hour; the motion of the heart was then observed gradually to return, and he recovered again, executed some business, and died the same evening."

Cheyne's "English Malady."

It is said of Fontana, that he acquired such command over the action of his heart, that he could accelerate, or retard his pulse at pleasure.

Concluding remarks.

From what has been said, it therefore appears, that as the structure of the two hearts is calculated to prevent either venous or arterial blood from being congested in the lungs, so the structure of the lungs is calculated to prevent any congestion of blood in the heart. Hence the two vital organs, the heart and the lungs, materially assist each other, so that whenever the function of one is disturbed, by the assistance of the other its functions are restored.

CHAPTER VI.

THE PULMO-CARDIAC FUNCTION.

The pulmo-cardiac function demonstrated; the author's account of this function; it regulates the quantity of blood in the heart; assistance derived from the lungs; their structure adapted for that purpose; utility of this function; its influence on respiration.

BESIDES the two important offices of the respiratory apparatus connected with the circulation of the blood, both of which may be considered as altogether depending on changes in the form and capacity of the thoracic cavities, there is a third, and, as I shall endeavour to show, an accessory function, which is performed by the lungs themselves; the pulmonary vessels serving as a *receptaculum*, or reservoir for receiving any surplus quantity of blood, whether venous or arterial, which the cavities of the heart cannot admit. In order to distinguish this function from all the others performed by the respiratory apparatus, I have denominated it the PULMO-CARDIAC FUNCTION.

Diverticulum sanguinis.

As the supply of blood to the heart can scarcely ever be uniform, unless, perhaps, during sleep, the return of the venous and the exit of the arterial blood being subject to constant irregularities, it is surprising that physiologists should never have inquired—By what means can the central organ of the circulation accommodate itself to such almost incessant variations in its supply of blood?

Nature of this function.

Whenever, from any cause, the systemic blood cannot find a ready exit from the left ventricle, and, at the same moment, there is no diminution in the supply of venous blood to the right auricle, an accumulation or congestion of blood must then take place within the cavities of the heart, and also in the coronary vessels. Therefore, in order to prevent such undue accumulation, the effects of which would be more or less injurious, further

The pulmo cardiac function described.

means become requisite besides the expansive powers of the parietes of the chest.

Regulates the quantity of blood within the heart.

This condition of the heart is constantly taking place ; for, as I have already said, unless when the body is in a state of perfect tranquillity, and all its functions undisturbed, the return of the venous blood to, and the exit of the arterial blood from the heart, are subject to constant changes. Every muscular movement—the state of the stomach—the exercise of the mind—the varied positions of the body,—all influence, directly or indirectly, both the influx and the efflux of the heart's blood.

Importance of such a function.

It is, therefore, important to discover by what means the heart can accommodate itself to such constant changes in the supply of blood ; and how it can prevent those disturbances in the circulation, which would be necessarily produced by irregularities in its supply to the different organs. This investigation will unfold a beautiful and simple contrivance for executing what has hitherto appeared to us a complex function of the economy.

The heart's own powers insufficient.

If there be only a slight increase in the quantity of blood within the heart, such additional stimulus, by increasing the vigour of the heart's movements, may, along with the elastic quality of the fibro-cartilaginous portion of its structure, which is placed at the roots of the large vessels, be alone sufficient to equalize the circulation. But if the increased supply of blood to the heart be so considerable that the surplus quantity cannot be received within its cavities, the *lungs* are then required to lend their assistance.

Assistance derived from the lungs.

Their structure adapted for this.

To fulfil this *pulmo-cardiac function*, the structure of the lungs is admirably adapted. The pulmonary vessels, being imbedded in a soft and yielding substance, are susceptible of various degrees of distention, so that they readily give way for the reception of any surplus quantity, whether of venous or of arterial blood, and retain it until it can be received within the heart. The very same structure, with which the lungs are endowed to enable the air-cells to accommodate themselves to those differences in the quantity of air which are constantly taking place during respiration, also enables the pulmonary vessels, in their turn, to accommodate themselves to the reception of the various quantities of blood which may be impelled into them.

Utility of this function.

A function is therefore performed by the respiratory organs, which is quite unconnected, either with oxygenating the blood, with aiding the return of the venous blood to the right heart, or with assisting the circulation in the pulmonary vessels. When it is considered how often, and by what slight causes, the current of the arterial blood is hindered from leaving the left heart, and how frequently the return of the venous blood is accelerated to the right heart, the *pulmo-cardiac* function must be regarded as one of primary importance.

Influence of the pulmo-cardiac function on respiration.

The *pulmo-cardiac* function exercises a remarkable influence on respiration; for whenever the egress of the arterial blood from the left ventricle is impeded by muscular contractions, and the exit of the systemic blood from the lungs into the left auricle is interrupted, the velocity of the blood in the veins will be increased, and venous blood must be congested in the pulmonary arteries. Thus, the blood being accumulated in the pulmonary arteries and veins, as well as in both hearts, respiration becomes quickened, and its frequency increased in proportion to the degree of impediment which is offered to the distention of the air-cells; the hurried respiration will continue until the circulation be equalized, until the heart has become tranquil; and until the congested lungs have been relieved of all surplus *quantity* of blood.

Accordingly, unless when the supply of blood to the heart is uniform, as is the case during sleep, respiration is constantly varying: sometimes the inspirations, and sometimes the expirations, are shortened or prolonged, or the duration of the interval between them is changed; all such variations being caused by alterations in the quantity of blood, which is contained in the pulmonary vessels.

The importance of this function of the lungs, accessory, and, as it were, subservient to the heart, is also pointed out in those diseases of the lungs, wherein the respiratory functions are not duly performed. Thus, whenever a portion of lung is no longer capable of oxygenating the blood from an obliteration of the bronchi, that portion becomes unfit to relieve the heart of any temporary congestion, the pulmonary vessels being obliterated, and a person under such circumstances cannot indulge in those exercises, or muscular exertions, which can be made without inconvenience by those whose pulmonary vessels are not obstructed.

CHAPTER VII.

THE VENO-PULMONARY FUNCTION.

This function demonstrated; an office of the venous system performed by the subcutaneous veins; these veins act as a diverticulum sanguinis; *this function illustrated; pulmo-cardiac congestion and the art of training explained; the pernicious effects of too full inspirations.*

Whilst the *pulmo-cardiac* function is employed in relieving the heart of any surplus quantity of blood which it cannot receive within its cavities, the *veins* will, in like manner, relieve the pulmonary vessels of any superabundant blood which they are not capable of receiving without interruption to the great function of respiration. This important office of the veins, which I have denominated the *veno-pulmonary function*, I shall endeavour to establish, by pointing out some facts connected with the structure and functions of the venous system, and also some phenomena connected with the circulation, which are constantly taking place.

An office of the venous system;

When describing the effects of the *musculo-cardiac* function on the circulation, it has been shown that certain muscles, when thrown into contraction, compress arteries as well as veins, and that both these systems of vessels are so placed, in relation to such muscles, as to be compressed whenever these muscles are thrown into action. It has also been pointed out that, whilst one class of arteries is employed to perform this important office in the circulation, there is another class which is not required to execute that function; these arteries being so placed in relation to the muscles, that the contractions of the muscles could not influence the circulation of their blood.

performed by the subcutaneous veins;

The division of the arteries into those vessels which are, and those which are not, influenced by muscular contractions, we shall also find applicable to the veins; one class of veins being so situated that the circulation of their blood is affected by the contractions of the adjacent muscles, whilst other veins are so protected, that they are never under the direct influence of the active organs of motion. Hence, as has been pointed out, in the limbs, the deep-seated veins which are intermingled with the muscles are influenced by every contraction of these muscles, whereas the subcutaneous or superficial veins, being placed externally to the *fascia*, are not affected by the action of the muscles of the extremities. Whilst, therefore, the chief function of the veins is to convey the blood back to the heart, there are likewise other offices executed by each of these subdivisions of the venous system.

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by forming a *diverticulum sanguinis.*

That the *subcutaneous veins* perform the office of a *receptaculum*, by receiving any surplus quantity of blood which cannot be admitted into the pulmonary vessels, in the same manner as we have seen that the pulmonary vessels themselves receive that blood which the cavities of the heart cannot admit, is illustrated by the phenomena which accompany different degrees of distention of these vessels.

This function illustrated.

The most remarkable of these phenomena is what we have constantly opportunities of observing, when the regularity of the circulation is disturbed by muscular exertions. If these exertions are made within certain limits, the pulmonary vessels, as has been already noticed, both arteries and veins, are endowed with powers of dilatation sufficient to contain the additional quantity of venous blood propelled forwards to the right heart, and also of containing the arterial blood impeded from leaving the left heart. But when the vessels of the lungs become congested, and cannot admit any more blood, not only is the systemic blood driven into those arteries which are not compressed by muscular contractions, but the venous blood which cannot find access within the thoracic cavity becomes accumulated and stagnates in the subcutaneous veins.

No more striking example can be given of this office of the subcutaneous veins than their distended appearance in the limbs of a person after making any violent exertion, or beneath the delicate skin of a *race-horse* after a severe gallop.

Pulmo-cardiac congestion explained.

But neither this accessory function of the subcutaneous veins, the increase in the heart's action, nor the aid which the respiratory organs afford, are always sufficient to prevent a congestion of blood within the cavity of the chest. Whenever muscular exertion has been violent or carried to its extreme limits, the accumulation of blood, both within the pulmonary vessels and the cavities of the heart, then becomes such, that the balance of the circulating and respiratory apparatus is destroyed; the congestion renders them incapable of sufficiently evacuating themselves, and the accumulation in the vessels of the lungs prevents the inspiration of a sufficient quantity of air for oxygenating the blood.

Its pernicious effects.

In this state of congestion, it sometimes happens that the parietes of one of the cavities of the heart are ruptured, or the pulmonary vessels give way, and a fatal hemorrhage ensues—or death may be caused by suffocation, as sometimes takes place from the convulsive agonies of childbirth. In animals that have died in the act of making a violent muscular exertion, it has frequently been found that life was not extinguished from the bursting of any of the heart's cavities, as some have supposed, but from their being so much over-distended with blood as to prevent the heart's action, and from the pulmonary vessels being, at the same time, so much gorged with blood as to prevent the ingress of the requisite quantity of air for the oxygenation of the blood. This condition of the thoracic viscera has been observed in *horses* that have died suddenly after severe galloping; and in some instances so violent had been the efforts to carry on respiration, that the diaphragm has been found in these animals torn, permitting even portions of the abdominal viscera to pass into the cavity of the thorax.

A congested state of the thoracic viscera from violent exertions, when not carried so far as to destroy life, may, however, go the length of producing such derangement of the circulation, as the respiratory and circulating organs combined have not the power to restore; and although, by a system of *training*, a power of adjusting these organs so as to carry on respiration during great exertions may be acquired to a surprising degree, yet, if the *pulmo-cardiac* congestion goes beyond certain limits, a permanent disturbance of the circulation takes place, and the functions of respiration and circulation are never afterwards perfectly restored.

Accordingly we may observe an almost infinite variety in the time which is required for tranquillizing the movements of the heart and lungs after they have been disturbed by any muscular exertion,—this depending on the violence of the effort as well as on the *condition*, as it is called, of the person by whom it has been made.

Training, —how explained;

These observations naturally lead us to inquire by what means a person can attain the power of regulating the respiratory and circulating organs so as to be able to continue making great muscular exertions until his muscular energy is exhausted, or in what consists the art of *training?* This subject has never sufficiently claimed the attention of physiologists; indeed, no one, as far as I know, except the ingenious John Bell, ever seems to have even made allusion to it, or to have considered whether any changes take place in the physical condition of the thoracic viscera of those who have been trained to perform feats of strength.

(The Anatomy of the Human Body, by John Bell, 1797)

"Do we not see that boxers and all the tribe of athletics cannot ever make those exertions unprepared? And what is the course of 'training' but a spare diet of generous food, with regular exercise and gradual exertions; till at last the two great functions of respiration and circulation, accompanying each other, are brought to the highest pitch, and the man becomes capable of exertions, before impossible or dangerous, now familiar or easy to him?"

(Sir E. Home's discovery)

A careful consideration of the varied functions of respiration and circulation, along with some points but lately discovered in the anatomy of the respiratory apparatus, will, I am persuaded, enable us to give a satisfactory explanation of the changes which take place in training, and will also explain several symptoms in the diseases of the thoracic viscera which have hitherto escaped pathological research.

its phenomena.

If we attentively examine the nature of training, or putting a person "in wind," we shall find that it consists in so regulating the respiration during muscular exertions, that any *pulmo-cardiac congestion* is prevented; this is effected by permitting the lungs to receive only such quantities of blood, during each inspiration, as will not destroy the proper balance or adjustment between the respiratory and circulating organs, whilst at the same time a quantity of air is inspired sufficient for oxygenating the blood. The muscular movements are thus allowed to proceed until the energy of the muscles becomes exhausted; for, as has been already mentioned, if *pulmo-cardiac* congestion goes beyond certain limits during any muscular exertion, the person becomes exhausted, not from the muscles being fatigued, but from the cavities of the heart and pulmonary vessels becoming so loaded with blood as to interrupt respiration.

An important part of the anatomy of the lungs.

(Philosophical Transactions, 1827.)

There is a circumstance regarding the anatomy of the lungs, first described by Sir E. Home, which it is of importance to notice here, as it appears to me materially to assist in explaining this peculiar feature in the function of the pulmonary apparatus. From his observations, it appears, that in porportion as the air-cells are distended, so is the circulation of the blood in the pulmonary vessels retarded, and, if the cells be completely distended, the pulmonary capillaries, from the obstruction caused by the over-distended air-cells, cannot transmit the blood to the pulmonary veins. He found that when the arteries of a sheep's lungs, in a state of collapse, were injected, the injection returned very readily by the veins; but if the air-cells were previously much distended, the injection could not be then forced into the pulmonary veins.[1]

It explains the pernicious effects of too full inspirations.

In further illustration of this important anatomical fact, it may be here remarked, that by very full inspirations the action of the heart is diminished, and the shorter and the more frequently the inspirations are made, the more rapid become the movements of the heart. When, also, from disease, a portion of lung is no longer capable of assisting in the oxygenation of the blood, that portion which remains sound having an additional duty to perform, respiration becomes increased in frequency, and there must necessarily take place an increase in the heart's action,—a circumstance which may explain that quickness of the pulse which has been considered as pathognomonic of tubercular phthisis.

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[1] The following is the account of the mode by which Sir Everard Home displayed this structure:—

"The cells of the lungs were filled with quicksilver, to show their utmost capacity, and the parts were afterwards immersed in rectified spirit, to prevent the cells from collapsing, when the quicksilver was allowed to escape. When the internal cavity of a single cell was exposed, immediately behind its internal membrane, the branches of the pulmonary artery, injected with red wax, were seen ramifying, as arteries do in common; these were accompanied by branches of the pulmonary vein, larger in proportion than those of the arteries, more numerous, and having valves, at apparently regular intervals, to prevent regurgitation of their contents. Besides the arteries and the veins, there were innumerable absorbents opening into the cavity of the cell; their valves were at very short distances, and, in their course, in the interstitial substance between the cells, they accompanied the veins. When the terminal branches of the pulmonary artery were traced, the injection was found to have stopped some way before the artery's termination, and the space beyond was filled with gas. The substance of the lungs, interstitial to the cells, when dried became transparent, and was found to be composed of a smaller order of cells, with transparent coverings, that freely communicated with one another, as well as with the cavity of the large cell they surrounded.

From the foregoing observations, we are warranted in concluding, that too full inspirations, by over-distending the air-cells, and thus impeding the pulmonary circulation, will prevent the continuance of any muscular exertion; but, if the inspirations be limited, so that the air-cells shall not be over-distended, then the free circulation through the pulmonary capillaries will not be interrupted, and the muscles will be enabled to act until their energy is exhausted.

Training modifies respiration.

That *training* consists in a person acquiring a certain control over the respiratory organs, and that one of its essential conditions is to limit the *inspirations*, can be shown by examining the mode in which respiration is performed by those who are properly trained for athletic purposes.

The phenomena of training illustrated; in dancers;

It may be remarked, that those who are even best trained for performing feats of strength require great care and nicety, in order to adjust the respiratory organs, before making any muscular exertion. The trained *dancer* commences his performance by increasing the movements of the body in a very gradual manner, and thus establishes an equilibrium between the respiration and circulation, so that afterwards he can perform the most rapid movements, and continue the greatest exertions until his muscular energy is exhausted, without suffering any interruption from the respiratory organs. It is the same with the *prize-fighter;* to retain his greatest physical powers, it is necessary that the muscular exertions be at first made, only in a very moderate degree; but if, from passion or too much excitement, he is induced to make too violent an effort at the commencement of a fight, the necessary adjustment in respiration is destroyed, his breathing becomes laborious, and he cannot avoid failing in his enterprise.

in pugilists;

In order still further to illustrate the condition of the respiratory organs which is necessary for allowing the continuance of powerful muscular exertions, I may remark, that the various contrivances which are resorted to for effecting this purpose all act by limiting the inspirations, thus preventing such a degree of distention of the air-cells, as would impede the ready flow of the blood from the pulmonary arteries into the pulmonary veins.

in running a race;

Hence, in running a race, it is found essential that the mouth be kept shut, a sufficient quantity of air entering by the nostrils for oxygenating the blood: experience having taught, that, if any additional quantity of air is inspired by the mouth, the proper balance between respiration and circulation is more or less destroyed, and the person is obliged to discontinue the exertion. The common practice for effecting this purpose is to put a pebble, or some such-like substance, into the mouth, by which the effort of retaining it keeps voluntarily the lips closed.

in reading aloud;

The reputation of Thelwall, a well-known teacher of elocution, was chiefly founded on the mode which he had of teaching his pupils to read aloud for a very lengthened period without fatigue, which was simply by making them *inspire* only through the nostrils. When the infant goes to sleep, it often puts one thumb in its mouth, and thus inspires only through the nostrils.

in stammering;

This mode of regulating respiration was known to Demosthenes, of whom we are told that, in order to correct some imperfection of his speech, he was in the habit of putting pebbles in his mouth;—there are many persons who stammer when they speak, but who are known to sing without any impediment.

in the effects of lozenges;

The effect of *lozenges* in subduing some coughs is, I am inclined to believe, to be attributable chiefly to the circumstance of the mouth being kept shut involuntarily whilst the lozenge is retained in the mouth, and thus inspiration is carried on alone through the nostrils. Neither is it at all improbable that, in some of those persons suffering from pulmonary affections who have derived benefit from using the *respirator*, the relief has been obtained by the inspirations being made chiefly through the nostrils.

and in tying a belt round the waist.

Artisans, also, whose avocations require them to make great muscular efforts, are in the habit of tying a belt tightly round their waists, thus preventing too great an expansion of the chest; and when the sailor prepares himself for battle, in order the more powerfully to exert himself at the gun, he ties a handkerchief firmly round his waist, by which, during the excitement of the fight, as well as from the powerful muscular exertions which he is compelled to make, the movements of the respiratory apparatus are confined within certain limits, and thus he is prevented from making such full inspirations as would disturb the balance of the circulation in the chest.

The pernicious effects of violent exercise on the circulation, as well as the mode of avoiding them, are well understood by those who professedly train persons for gymnastic exercises. It is by them considered a great nicety in the process of training, never to allow *pulmo-cardiac* congestion to be carried so far as to render the thoracic viscera unable to remove without difficulty, whenever the muscular exertions which produce the congestion have ceased, all surplus blood from the pulmonary vessels. When attention has not been paid to this circumstance, and when from an over-distention of the air-cells the congestion has exceeded certain limits, an embarrassment in breathing continues, and, in some instances, prevents the person from again following such exercises throughout the remainder of his life.

The same phenomena may be observed in those, in whom congestion is caused from having made a violent exertion to which they are not accustomed, and who continue ever afterwards to suffer from a disturbance in the thoracic circulation. The observations, however, which I have to make on this subject will be introduced more appropriately when we come to consider the pernicious effects of violent exercise on the respiratory and circulating apparatus.

CHAPTER VIII.

PHENOMENA CONNECTED WITH THE RESPIRATORY AND CIRCULATING ORGANS.

The instinctive acts of the economy explained; as laughter, crying, screaming, weeping, sobbing, and sighing; vomiting, hiccup, sneezing, and coughing; their effects on the circulation; sea-sickness explained; modes of relieving it; diving explained; effect of swinging on the circulation; how the balance of the circulation is preserved in different postures of the body; this illustrated in the circulating organs of animals; subject concluded.

There are many important phenomena which, I am persuaded, will admit of a satisfactory explanation, now that the intimate connexion between the functions of the heart and respiratory apparatus has been pointed out. The purposes which these phenomena, although they are always taking place in health, are intended to serve in the animal economy have not even been contemplated, far less satisfactorily explained.

Unsatisfactory result of experiments on animals.

It would have undoubtedly been well for medical science if physiologists, in place of contriving fruitless and contradictory experiments, and torturing innumerable living animals, had been satisfied with observing the phenomena which are constantly developing themselves in the healthy state of the body, and had they watched with equal care the various changes which they undergo in diseases. Indeed, it is surprising that the different *instinctive acts* of which I am about to treat, should not have long since led physiologists to consider for what purposes, and how, such remarkable acts were produced. On a little reflection, it must have appeared that the uniformity of the phenomena, and the similarity in the circumstances under which they were always developed, would have led to some explanation of their effects and of their influence upon the animal economy.

Instinctive acts of the economy never yet explained.

In pursuing this subject, we shall find, that equally beautiful

These acts enumerated;

contrivances to those which the economy possesses for preserving and restoring parts of the body that have been injured or destroyed, are also wisely provided for restoring and sustaining the functions of organs or systems of organs when they have been deranged,—all which may, indeed, be considered as so many proofs of a *vis conservatrix naturæ.* When, for example, the bronchi are irritated by a particle of dust, there is an immediate exudation of mucus, followed by a violent cough to expel the extraneous substance. If a mote falls into the eye, profuse lachrymation and sneezing immediately come on, by which the extraneous substance is expelled; or, if anything offensive is taken into the stomach, there soon follow sickness and vomiting. So, in like manner, we shall find that, whenever the circulation in the heart is disturbed, either by physical or moral causes, changes take place *instinctively* in the functions of the respiratory apparatus, by means of which the healthy condition of the circulation is restored.[1]

Thus I shall endeavour to show that *laughing*, *crying*, *sighing*, *yawning*, *weeping*, *coughing*, *sneezing*, *hiccup*, and *vomiting* are all acts which are instinctively resorted to, in order to effect certain changes in the circulation of the blood in the heart for some essential purpose. I shall also endeavour to explain how certain sensations in the head, such as the *giddiness* felt from swinging, turning round rapidly, or from sudden alterations in the position of the body, *sounds* in the ears, *false images* appearing before the eyes, and *sea-sickness*, depend upon the function of respiration, and are prevented in certain individuals by a power which they possess, or which they may have acquired, of modifying their breathing.

they restore a disturbed circulation.

For each of these purposes, however, to which I have now alluded, it will be found that only one of the offices of the respiratory apparatus is more especially employed. Thus, full *inspirations* are made in order to relieve the head, because they accelerate the return of the venous blood to the right heart. Deep *expirations* will relieve the left heart of any superabundant blood which it may contain, and they will also aid the transit of the systemic blood along the great arterial trunks. The *musculo-cardiac* function will at all times, by impeding the transit of the arterial blood in some arteries, increase its quantity within the left ventricle, when the heart is required to act with additional vigour; whilst the *pulmo-cardiac* function will, by regulating the quantity of blood in the heart, prevent congestion, and ward off the pernicious effects of any irregularity in the supply of blood to that organ.

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[1] "*Sympathies* raise within us propensities of the innermost kind, which have for their object the removal of some uneasy and painful sensation. Of this kind are *yawning*, *stretching*, *sneezing*, *sighing*, *coughing*, *hiccuping*, *vomiting*, and the like."—Jackson *on Sympathies*.

By modifying, therefore, the inspirations and expirations, and as the pulmonary vessels are at the same time capable of receiving various quantities of blood, we perceive how the system itself possesses the means of restoring that balance of the circulation, which is so often interrupted by moral causes operating on the heart, and by physical causes acting on the organs of respiration.

Let us consider these instinctive acts separately, and as they present themselves in the healthy state of the system, which will prepare us afterwards for examining the various modifications which they undergo in the diseases of the thoracic viscera; for it is not to be expected that a rational explanation could have been given of the diseased changes in the function of any organ until the phenomena of its healthy state had been previously investigated.

Laughter.—The movements of the chest which take place during fits of laughter,[1] and likewise in the acts of crying, weeping, sobbing, and sighing, are all resorted to by the system, in order to effect alterations in the *quantity* of blood both in the lungs and in the heart, when the circulation has been deranged by mental emotions.

Laughter—its effects on the circulation.

The deep inspirations, and the short and frequent expirations made in the act of *laughing* have a direct influence on the heart, increasing the quantity of blood within its cavities, in the same manner as the quantity within them is increased by muscular contractions.

This condition of the heart, as may be anticipated, varies according to the violence and duration of the paroxysms of laughter. When these are moderate the mind is only exhilarated, or, to use a common expression, "the heart becomes joyful;" but, if laughing be prolonged beyond certain limits, a series of effects, more or less injurious, frequently supervene. Pain in the cardiac region, and headache then come on; and, if the paroxysm be immoderate, the quantity of blood propelled into the brain is so greatly increased, that the intellectual powers become excited, and sometimes to such a degree as to cause their temporary aberration. Even convulsions follow immoderate fits of laughter; and I have known death take place from excessive laughter caused by *titillation*.

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[1] "Laughter," says Hufeland, "is one of the greatest helps to digestion; and the custom prevalent among our forefathers, of exciting it at table by jesters and buffoons, was founded on true medical principles. In a word, endeavour to have cheerful and merry companions at your meals; what nourishment one receives amidst mirth and jollity will certainly produce strength."

Case.

Mariotti's *Italy*, vol. ii.

A young woman was induced to creep under a bed, and, when secured in that position, her feet were tickled by one of her companions, and such was the violence of the paroxysm of laughter which it produced, that convulsions supervened, which terminated fatally;—we are told that Petro Aritius died of a fit of laughter on hearing of the infamy of his sister.

A disturbed action of the heart is usually observed in those affected with *hysteria*, which may account for the paroxysms of laughter, the hiccup, and many of the more remarkable pathological phenomena which are characteristic of that disease.

Case.

A lady, of a nervous temperament, always had, when a fit of laughter was prolonged beyond a certain time, a regular hysterical paroxysm.

Effects of laughter on a diseased heart.

Laughter, indeed, greatly disturbs a heart which is already disordered. This was strikingly exemplified in a person, who had a disease of the heart, and who never could indulge in laughing without the increased action of the heart by which it was followed causing violent headache.

Case.

A youth, who was recovering from a disorder in the heart, on reporting his progress, observed that the symptoms had been much aggravated in consequence of having laughed violently the day previously—an effect of laughing which he had often before experienced.

The sardonic laugh.

There is a laughter that accompanies rage, indignation, and delirium, and which, from its resemblance to the effects of the *apium risus*, an herb of Sardinia, has been called the *risus sardonicus*. "Sardinia," says Solinus, "produces an herb which has this singular property, that, whilst it destroys whoever eats, it so contracts the features, particularly the mouth, into a grin, as to make the sufferer to appear to die laughing."

Crying—its effects on the circulation.

Crying, *screaming*, and *roaring*, are different degrees of one act, which consists in a succession of violent and long-protracted expirations, and will have the effect, by diminishing the circulation in the pulmonary arteries, of unloading the left heart and large arteries of any surplus quantity of blood, caused by the action of the heart having been disturbed, whether by moral causes or from bodily pain. Hence the relief which those who suffer mental affliction, or bodily pain, derive from crying—an act which is resorted to throughout the whole animal kingdom to relieve the heart from the hurtful effects of pain.

Hurtful effects of not crying.

From the same cause arise the great langour in the circulation, and even the pernicious effects, which have so often been known to follow the endurance of severe bodily pain without crying. A man who made no signs of great suffering during a military flogging dropped down lifeless.

Cooper.

We see many examples of *crying* in hysterical women, and the *screams* from fear or from mental agony must have a powerful influence in unloading a congested heart.

Salutary effects of the cries of the infant; (Byron)

The *cries* of the infant which are made at the moment of its birth—

> "The piping cry of lips that brook no pain,"—

as the poet has well remarked, have a great influence on the circulation, the violent expirations powerfully contributing to propel the blood through the pulmonary vessels, then only for the first time called on to perform their functions. The salutary influence of the *cry* is so well known to nurses, that it is their common practice, when they have tied the umbilical cord, or immediately before doing so, to sprinkle some cold water upon the face of the infant in order to make it cry!

"When the child is born," observes John Bell, "the function of the placenta declines exactly in proportion as that of the lungs strengthens. If the child do not breathe freely, the cord will continue to beat, the placenta still continuing to perform the function of the lungs; but when the child begins to *cry* freely, the pulse of the cord and function of the placenta at once cease.

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If the child breathe freely, but yet do not cry, and you tie the cord, it is instantly forced to cry for a fuller breath; and, if a rash person tie the cord prematurely when the child neither cries nor breathes, he thus cuts off the function of the placenta before the function of the lungs is established, and often the child is lost."

(See the Anatomy of the Human Body)

"Nature has wisely ordained, that by these very efforts, the power and utility of functions, so essential to life, should be developed, and rendered more perfect with every inspiration. Hence it follows, that those over-anxious parents, or nurses, who continually endeavour to prevent infants from crying, do them a material injury; for by such imprudent management, their children seldom or never acquire a perfect form of the breast, while the foundation is laid in the pectoral vessels for obstructions and other diseases."

(*Lectures* by D. Willich, 1702)

and sobbing and sighing;

Sighing, *sobbing*, and *weeping*, which are different degrees of one act, also appear to be employed by Nature to relieve the heart from congestion. The full inspirations which are made in sighing and sobbing, by withdrawing the venous blood from the head, will assist in restoring the balance of the circulation, both within the head and chest, when it has been destroyed by some violent mental emotion or bodily pain.

> "He sighed a sigh so porteous and profound, as it
> Did seem to shatter all his bulk, and end his being."

(Shakspere)

and weeping.

Weeping, also, which consists in irregular respiration, either with or without sighing, is an instinctive act made to facilitate the pulmonary circulation, and relieve that congestion in the heart which is caused by grief.

Hence arise the baneful effects, and the sensation of fulness, "the fulness of heart," and even of pain in the cardiac region, so frequently experienced by those who have not wept when the mind has been greatly agitated.

> . "You think I'll weep;
> . . . . No! I'll not weep!
> I have full cause of weeping; but this heart
> Shall break into a hundred thousand flaws
> Ere I'll weep!"

Shakspere.

In animals.

Weeping, like crying, may be observed in the lower animals as well as in man. The dog is often observed to weep. Linnæus asserts that the female *bear* sheds tears when in grief; and the weeping stag has not escaped the notice of our immortal poet.

> "Under an oak, whose antique root peeps out
> Upon the brook that brawls along this wood,
> To the which place a poor sequester'd *stag*,
> That from the hunter's aim had ta'en a hurt,
> Did come to languish; and, indeed, my Lord,
> The wretched animal heaved forth such groans,
> That their discharge did stretch his leathern coat,
> Almost to bursting; *and the big rained tears*
> *Coursed one another down his innocent nose*
> *In piteous chase.* And thus the hairy fool,
> Much marked of the melancholy Jacques,
> Stood on the external verge of the swift brook,
> *Augmenting it with tears.*"

Shakspere.

Effects of Yawning.

Yawning is another instinctive act of the economy which frequently takes place when a person is awaking from sleep, or when fatigued. The full inspirations which are made during yawning, along with the pressure made by the voluntary muscles when stretching the body, which usually accompany the yawning, both, by their influence on the circulation, contribute to give vigour to the heart.[1]

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[1] I have alluded to *yawning* as one of the symptoms which ushers in sleep; but it follows as well as precedes this state. "It seems an effort of nature to *restore the just equilibrium between the flexor and extensor muscles.* The former have a natural predominancy in the system; and on being fatigued, we, by an effort of the will, or rather by a species of instinct, put the latter into action for the purpose of redressing the balance and poising the respective muscular powers. We do the same thing on awaking, or even on getting up from a recumbent posture; the flexors, in such circumstances, having prevailed over the extensors, which were in a great measure inert."—Macnish *on Sleep.*

A very different explanation of yawning has been given by Richerand:—"*Yawning* is effected in the same manner as *sighing* and *sobbing;* it is the certain sign of ennui. The fatigued inspiratory muscles have some difficulty in dilating the chest, the contracted lungs are not easily penetrated by the blood which stagnates in the right cavities of the heart, and produces an uneasy sensation, which is put an end to by a long and deep inspiration; the admission of a considerable quantity of air is facilitated by opening the mouth widely, by the separation of both jaws. One yawns at the approach of sleep, because the agents of inspiration, being gradually debilitated, require to be roused at intervals. One is, likewise, apt to yawn on waking, that the muscles of the chest may be set for respiration, which is always slower and deeper during sleep. It is for the same reason, that all animals yawn on waking, that the muscles may be prepared for the contractions which the motions of respiration require. The crowing of the cock, and the flapping of his wings, seem to answer the same purpose. It is in consequence of the same necessity, that the numerous tribes of birds in our groves, on the rising of the sun, warble and fill the air with harmonious sounds. A poet then fancies he hears the joyous hymn, by which the feathered throngs greet the return of the God of light."—Richerand's *Physiology.*

Effects of vomiting on the circulation—

Vomiting.—The influence of vomiting on the circulation ought likewise to be noticed, being an *instinctive act* employed by the economy, not only for the purpose of evacuating pernicious substances in the stomach, but also for assisting the left heart and large vessels for propelling the systemic blood when the capillary circulation has been disturbed. The same expulsatory effort which removes the contents of the stomach, along with the pressure of the abdominal parietes and the collapse of the walls of the chest, which take place during vomiting, must also have a considerable effect on the circulating apparatus, and consequently, *spontaneous* vomiting is resorted to by the economy, for the relief of some diseases depending upon, or caused by a disturbance in the action of the heart.

in the Asiatic cholera;

In the Asiatic cholera, in which disease, the blood, from having acquired a preternatural degree of viscidity, cannot be circulated with its usual facility, the disease is often accompanied with vomiting; and it is well known, when spontaneous vomiting does take place, that its influence in aiding the circulation of the viscid blood is such, that the patient generally recovers from that formidable malady; and the good effects of artificial vomiting also in the treatment of *cholera* is well established.

in febrile diseases;

There are likewise many febrile diseases, wherein the effects of vomiting are equally manifest; and it may be remarked, that the relief which the act of vomiting affords in such ailments does not arise from the evacuation of any noxious contents from the stomach, but by producing an almost immediate change in the action of the heart and capillary system.

The *nausea* which precedes the act of vomiting, by diminishing the movements of the heart, must also be taken into consideration when endeavouring to account for the remedial effects of emetics, and it has usually been observed, that an emetic, which causes a protracted nausea, is often a more effectual remedy, in some diseases, than one which produces speedy vomiting. In the use of emetics it is, therefore, essential to discriminate, whether it be requisite merely to evacuate the stomach of its pernicious contents, or to act on the disordered organs of circulation.

It may also be remarked, that vomiting frequently takes place whilst a person is recovering from syncope, the musculo-cardiac function being then resorted to by the *vis conservatrix* in order to assist in restoring the vigour of the languid circulation.

in syncope;

The fits of vomiting which accompany *sea-sickness* likewise produce temporary relief, by withdrawing venous blood from the head; but, as I shall subsequently point out, no permanent relief can be obtained from sea-sickness until the person acquires a power of modifying his breathing.

in sea-sickness;

The sickness and vomiting which so frequently accompany *pregnancy* will, in all probability, be also found to depend on a disturbance in the circulation, and may explain the decided relief which is derived from the abstraction of a small quantity of blood under such circumstances.

in pregnancy.

Coughing.—What I have said regarding vomiting applies also to *coughing:* the act of coughing being resorted to by the system, both for the purpose of evacuating pernicious secretions from the mucous surface of the lungs, and likewise for restoring the thoracic circulation when it has been disturbed. Hence the various coughs and paroxysms of coughing which accompany diseases of the heart.

Effects of coughing on the circulation;

A young lady was subject to a cough for several years, which was always caused by laughter, and which came on in paroxysms so loud as to be heard in a distant room.

(Case)

Sneezing is by no means an uncommon act in disturbances of the heart. It is an instinctive act, like that of coughing and vomiting, and is not only an effort made to remove extraneous substances from the cavities of the nose, but is also resorted to by the system for restoring the circulation, when that has been disturbed.

and of sneezing.

"Many children sneeze before they respire," and a paroxysm of sneezing is one of the first symptoms of catarrh; the violent muscular movements made in sneezing having a great influence on the circulation, and in restoring the action of the cutaneous and pulmonary capillaries which had been deranged.

Darwin's *Zoonomia.*

By paroxysms of sneezing the violent expirations increase the velocity of the circulation, and drive the blood to the head, often causing hemorrhage from the over-distention of the vessels of the Schneiderian membrane, in the same manner as a paroxysm of coughing causes hemorrhage from the lungs when there has been *pulmo-cardiac* congestion.

Case.

A young man suffered severely from a malady of the heart, and, during nine years that he was afflicted by it, his nose bled sometimes every day, from which spontaneous hemorrhage he always experienced more or less relief.

Sympathy between the nose and heart.

There appears to be an intimate connexion or sympathy between the heart and the *organ of smell*, certain odorous substances having a great influence on the heart's action; the power which *sternutatories* have in restoring the vigour of the heart during a fit of syncope, and in asphyxia, is well known. The phenomena of disease further illustrate this sympathy between the organ of smell and the heart.

Case.

A youth, whose circulation was disordered, and who was subject to violent paroxysms of convulsions, sometimes had the strongest desire to take *snuff*, with which he used to fill his nostrils most greedily; the effect of which was always to excite a paroxysm of his disease.

Effects of hiccup on the circulation.

Hiccup, which is a sudden sonorous inspiration, seems likewise to be an act connected with some disturbance in the circulation of the blood within the thorax. It is usually preceded by a paroxysm of laughter, and the short violent inspirations, which form the most striking characteristic of hiccup, will assist in unloading the left heart wherein the blood has been congested.

Case

A gentleman had an immoderate fit of laughter which lasted upwards of an hour, and after it had ceased it was succeeded by a violent hiccup, which continued several hours, and caused great uneasiness in the chest; and he was relieved by the application of leeches, and the internal use of antimony.

Hiccup is also one of the last acts of the dying, and it is a striking symptom in fatal strangulation of the intestine.

Modifications of respiration in running, &c.:

Besides the various instinctive acts that I have endeavoured to explain, modifications likewise take place in the duration of the inspirations and expirations when a person makes any very powerful but short muscular effort, such as to run, leap, or raise a very heavy weight.

In *running* a match, not exceeding one hundred yards, or in leaping, the exertion is accomplished during the period of one inspiration, and the long inspiration made by a pavior or blacksmith, whilst raising the hammer of great weight, is always followed by a violent expiration, accompanied with a deep and audible sigh ; the effect of which is, by restoring the balance of the circulation, to prevent congestion either within the lungs or heart.

In raising a weight.

Sea-sickness explained.

It is from a want of this power of adjustment or co-operation in the respiratory and circulating organs that we can explain how certain individuals suffer from *sea-sickness.* Wollaston observed, that, in those who did not suffer sickness at sea, their respiration was altered. In waking from very disturbed sleep, he found that his inspirations were not made with the accustomed uniformity, but were interrupted by irregular pauses, with an appearance of watching for some favourable opportunity to make the succeeding effort, and it seemed as if the act of inspiration were in some manner to be guided by the tendency of the vessel to pitch with an uneasy motion.

"After I had been harassed," observed that ingenious philosopher, "by sea-sickness for some days, and had in vain attempted to account for the difference between the inexperienced passenger and those around him more accustomed to the sea, I imperceptibly acquired some power of resisting its effects, and had the good fortune to observe a peculiarity in my mode of respiration evidently connected with the motion of the vessel, but of which, in my enfeebled state, I was unable to investigate either the cause or consequence. In waking from a state of very disturbed sleep, I found that my inspirations were not taken with the accustomed uniformity, but were interrupted by irregular pauses, with an appearance of watching for some favourable opportunity for making the succeeding effort, and it seemed as if the act of inspiration were in some manner to be guided by the tendency of the vessel to pitch with an uneasy motion.

"The mode by which I afterwards conceived that this action could primarily affect the system was by its influence on the motion of the blood ; for, at the same instant that the chest is dilated for the reception of air, its vessels become also more open for the reception of the blood, so that the return of blood from the head is more free than at any other period of a complete respiration. On the contrary, by the act of expelling air from the lungs, the ingress of blood is so far obstructed, that, when the surface of the brain is exposed by the trepan, a successive turgescence and subsidence of the brain is seen in alternate motions with the different states of the chest."

See *Phil. Trans.*, 1815.

Modes of relieving sea-sickness;

These views of the cause of sea-sickness accord with the means which are usually resorted to for its relief. One mode is to place the body in such a position that the weight of the column of blood in the head will be diminished as much as possible during the "pitching" of the ship; and this may be effected by the horizontal position, and also by placing the head near to the centre of the ship.

by the position of the body;

The other mode of warding off sea-sickness is by resorting to those means which modify the respiration, and by which congestion within the head and the concomitant vomiting are prevented.

by limiting the inspirations.

The common practice of tying a belt tightly round the waist, of avoiding conversation, and of keeping the mouth shut, which those who run races readily accomplish simply by having a small pebble, or such-like substance, constantly in their mouths, all assist, by limiting the expansion of the parietes of the chest, to regulate the breathing in such a manner that the balance of the circulation is preserved during all the different motions and positions of the vessel.

Sea-sickness aggravated when the heart is diseased.

The disagreeable effects of the motion of a ship, by disturbing the circulation of the blood, I have repeatedly known to occur in an aggravated degree in those who have been affected with some disease of the heart. Such individuals suffered from sea-sickness not only with unusual severity, but they had also many uneasy sensations continue, more particularly that of the ship's motion, for a considerable time, even for weeks, after being on shore.

Those who are not accustomed to travel rapidly in a carriage or on a railroad are also apt to suffer from giddiness, or some unpleasant feelings in the head, during a journey. I have known instances of uneasy sensations and feelings of the motion of the carriage continue for several days in those who have had some affection of the heart. On the other hand, as has been already remarked, all these motions produce exhilarating effects on those who are accustomed to them, and who are in the enjoyment of health.

The art of diving explained;

On a similar adjustment of the respiratory and circulating organs consists the art of *diving*. The power of remaining under water depends on the diver, previously to immersion, inspiring the greatest quantity of air which the lungs can contain, without the distending of the air-cells to such a degree as to interrupt the circulation through the pulmonary capillaries. Thus he can remain under water till the air which has been inspired is no longer fitted for oxygenating the blood; whereas a person who has not, from experience, acquired such a power of adjusting the thoracic viscera cannot remain under water, from the feeling of suffocation immediately succeeding submersion, which is caused by congestion of blood within the pulmonary vessels.

provisions for in certain animals;

In those animals which can remain under water a considerable time, and in the class of *amphibia*, we find that there are peculiarities of structure contrived either to avert pulmonary congestion, or to supply the lungs with an extra quantity of air. Thus, in the *otter*, the inferior *vena cava* is large and tortuous, so that when the animal goes under water that vein receives a portion of the returning blood, and retains it until respiration is again performed, and the pulmonary circulation is established. This animal also has an immense network of subcutaneous veins which contribute to the same office. In some *reptiles* the trachea, where it enters the lungs, forms capacious vesicles which serve as a reservoir, enabling the animal to remain under water as long as the air which they contain is sufficient for the arterialization of the blood.

in the otter;

in some reptiles.

Effect of swinging on the circulation.

Swinging must likewise have the effect of alternately increasing and diminishing the pressure of the blood within the head, according to the differences in the weight of its column, in the various attitudes which the body assumes when rising and falling in the swing. Whilst the head is ascending there will be little or no change in the degree of pressure which is made upon the brain, as far, at least, as any alteration in the weight of the blood's column is concerned; but when the feet ascend and the head is placed downwards, then a column of blood will press upon the brain with a gravity in proportion to the elevation of the extremities and depression of the head.

Such increase of pressure on the brain is quite sufficient to account for the giddiness which many experience in swinging, whilst those who do not suffer such uneasy feelings avoid them by an involuntary effort in breathing, by which the action of the respiratory organs is modified. For, as has been already pointed out, a certain adjustment in the inspirations withdraws venous blood from the brain at the moment when the column of arterial blood is such as to exercise upon it an undue pressure. This effect of swinging and of turning round rapidly, upon the circulation, may explain the benefit derived in the treatment of some cases of *insanity* by employing rotatory motions.

How the balance of the circulation is preserved in different postures,

In the same manner we can account for the power which some individuals acquire of "standing on the head," as tumblers and actors on the stage, without suffering giddiness or headache. The balance of the circulation in such varied positions of the body is preserved by the inspirations and expirations being so modified that no surplus quantity of blood is permitted to go to the head, but finds a receptacle in the pulmonary vessels.

and modified according to the habits of different animals.

Contrasted with the uneasy feelings experienced from changes of posture or unusual motions of the body, it is interesting to observe the perfect arrangements of the circulating organs of some of the lower animals, which enable them to perform the various movements their habits and necessities require. The rapid motions and varying positions of the body of those which live on trees or amongst rocks, the flight of birds, the habits of amphibious animals, all require certain peculiarities in the structure and function of the respiratory and circulating organs, which are not necessary for the human species.

Subject concluded.

Having endeavoured to point out that the *pulmo-cardiac* and *musculo-cardiac* functions, along with the influence which respiration exercises on the circulation, unfold the means which Nature employs for supplying at all times the heart with a requisite quantity of blood, as well as for preventing those congestions to which the thoracic viscera are constantly exposed, it may be reasonably anticipated that a knowledge of these functions will enable us to account for many phenomena in the diseases of the thoracic viscera which have hitherto been inexplicable. Indeed, in almost every affection of the heart we shall find the function of respiration more or less disturbed, the diseases of the heart influencing the functions of the lungs, as much as the diseases of the lungs alter the condition of the heart.

In conclusion, I may remark, that it is by the *musculo-cardiac*, the *pulmo-cardiac*, and the *veno-pulmonary* functions combined, and by the influence of the inspirations and expirations variously modified, that the respiratory organs can, under all circumstances, alter the supply of blood, not only to the heart and lungs, but also to the brain and spinal cord. When, therefore, we extend our pathological researches to the various phenomena of these important functions, we must always keep in mind the influence and dependence which the functions of these three vital organs, the tripod of life, have on each other; and that, for duly regulating the circulation of the blood, it is requisite that the brain, as well as the heart and the lungs, should constantly preserve an accordance and co-operation in all their actions; and finally, that, whenever their harmony is interrupted, many pathological conditions supervene, characteristic of and depending on irregularities in the distribution of the vital fluid.

CHAPTER IX.

RECIPROCAL INFLUENCE OF THE HEART AND MUSCULAR SYSTEM.

Difference in the phenomena accompanying the functions of the voluntary and the involuntary muscles; the different offices fulfilled by muscular movements; effects of muscular movements in restoring the heart's vigour in syncope, and in diseases.

Difference in the phenomena caused by the voluntary and involuntary muscles.

Purposes of their actions.

THE functions of the heart are variously changed by the action of the muscles, as much so as the action of the muscles is changed by the action of the heart. When inquiring into the influence of the action of the muscular system on the circulation, we must carefully distinguish those phenomena which depend upon the functions of the voluntary muscles, from those which depend upon the functions of the involuntary muscles,—or from those of animal and organic life. The voluntary muscles are thrown into action, either for the purpose of furnishing the heart with an additional quantity of blood, by the pressure which they make on the contiguous arteries and veins; or they are employed by the *vis conservatrix naturæ* to cause changes in the circulation of the blood, for mitigating the symptoms of disease.[1]

Muscular movements must, it is apparent, cause various changes in the condition of the heart. Thus it happens, that whenever the heart is unusually empty of blood, which takes place in *syncope*, caused by a profuse spontaneous hæmorrhage, or by a copious blood-letting, the voluntary muscles are then thrown into violent movements, which are resorted to by the *vis conservatrix* to restore the vigour of the heart, by increasing the quantity of its blood. The acts of *sneezing*, *hiccup*, *sobbing* and *crying*, from the muscular movements which accompany them, will likewise influence the heart's functions.

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[1] "The sympathies of *spasm* and *convulsions* more generally occur when there is a loss of balance in any part of the circulating system. *By such violent exertions of the muscular system the balance may probably be again restored.*"—Jackson *on Sympathies*.

CHAPTER X.

RECIPROCAL INFLUENCE OF THE HEART AND THE CUTANEOUS AND MUCOUS SYSTEMS.

Influence of the heart on the cutaneous capillaries; influence of the cutaneous capillaries on the heart; consent between the heart and the skin; influence of the mucous system on the heart: influence of the heart on the mucous system.

Reciprocal influence of the heart and cutaneous system.

THE heart is intimately associated with the cutaneous system, both by its capillaries and its nerves.

"With regard to the *balance* between the *heart* and extreme *vessels*," observes the learned Cullen, "he cannot fail to remark, that although the interruption or diminution of perspiration is often owing to cold constricting the vessels, and increasing their resistance to the action of the heart; yet it is at the same time evident, that it frequently may be owing to the weakness of the heart not pushing the blood with due force towards the surface of the body, that this last is rendered more liable to be affected by cold. This disposition, to be affected by cold, may take place not only occasionally, as it may in most persons, but seemingly it subsists in some through a great part of life, and therefore, may be considered as distinguishing the different conditions and temperaments of men." Cullen.

Effects of titillation.

There is no more striking proof of the consent between the heart and the skin, through the medium of the nervous system, than the effect of *titillation*. When employed within certain limits, so as to occasion laughter, titillation is accompanied merely by a temporary increase in the action of the heart; but, as I have formerly stated, if carried further, the laughter then acquires the character of hysteria; if it be still longer persevered in, convulsions may be ultimately produced; and instances have occurred where it has been carried so far as to prove fatal.

Chap. X.

Reciprocal influence of the heart and mucous system.

The *mucous* system, like the cutaneous, is intimately associated with the heart, through the medium both of its capillaries and its nerves. Whether cold or warm air be inhaled, or cold or warm substances be brought into contact with the alimentary canal, the same effects are produced on the functions of the heart, as similar applications to the skin would produce upon the heart.

This sympathy of the skin becomes an important channel for the administration of remedies in diseases of the heart.

CHAPTER XI.

RECIPROCAL INFLUENCE OF THE HEART AND NERVOUS SYSTEM.

Influence of the nervous system on the heart; influence of the heart on the nervous system; the blood the chief cause of this influence; blood the first element of life; condition of the cerebro-spinal system modified by changes in the functions of the heart; illustrated in sleep and wakefulness; conflicting theories of the nature of sleep; explanation of the author; the phenomena that precede sleep diminish the vigour of the circulation; those that precede wakefulness increase it; the general circulation equalized during sleep; the proportion of the arterial and venous blood changed during sleep and wakefulness; the modifications of sleep are important symptoms in diseases of the heart.

Influence of the heart on the nervous system;

WHATEVER be the influence which the nervous system exercises on the heart, in a much greater degree does the heart influence the nervous system.

In conducting their researches, physiologists do not appear to have duly considered the influence of the heart on the brain and spinal cord; but the anatomical facts, which have been pointed out, will, I am fully persuaded, enable us to account for many physiological, as well as pathological phenomena which have not hitherto been satisfactorily explained. (See page 41)

by the communication of nerves,

The sympathy between particular organs has been supposed to depend chiefly upon the relation which subsists between them, through the medium of the nervous system: such organs being supplied with nerves, either from the same trunks, or from anastomosing branches of the same nerves.

and by the blood.

That some organs are intimately associated, and that their various functions co-operate with each other in consequence of direct nervous communication, is quite certain; but there is likewise another source of consent, and this depends on the *blood*. Of the influence of the blood, no more striking example can be found than in the heart and brain; for, besides the relation, which is established between these two vital organs from the intercourse of nervous fibres, in an equal, and, perhaps, even in a still far greater degree does this co-operation depend on the *blood*. "Out of the heart are the issues of life." It is the blood that forms the vital link between the heart and the brain. Indeed, the phenomena of life seem wholly to arise from the impression which is made by the blood upon the nervous centres.

Though we do not comprehend what the "mysterious principle of life" is, yet we have sufficient evidence that the nervous energy, sensorial power, or by whatever abstract terms it may be denominated, depends on, and is modified by the quantity of *blood*, and by the regularity of its circulation within the brain: the energy of the brain, like that of all other organs, entirely depends on its supply of blood. No more, indeed, can the brain perform its functions without blood, than the heart can carry on the circulation without the brain.

Blood the first element of life.

The *life* of a part, it may be truly said, is far more depending on the supply of blood, than upon its nervous energy: a part can live without nerves, but without blood it decays. "The blood of it is for the life thereof." The nervous system enables the lungs and the stomach to prepare the blood, but the nervous system cannot do so, unless it has itself a proper supply of the vital fluid.

Dependence of the nervous system on the blood.

The dependence of the brain on the *blood* for the due performance of its functions is strikingly illustrated by the effects which changes in the circulation have in causing various states of mind, such as watchfulness, irritability, and sopor, as well as those different shades of intellectual energy so remarkable in the same person at different times. Hence we shall find that a vast number of disturbances in the brain's functions arise entirely from disturbances in the circulation, and that most of these functional changes are the effects of some primary disorder of the heart.

Illustrated in the effects of the passions.

That the action of the heart is influenced by mental emotions is well known; and it must have been this influence, particularly the effects of joy and grief, which led the ancients to place the seat of these passions in the heart, and to employ the word "Heart" to express the moral sentiments.

Illustrations of

Of the sympathy between the heart and nervous centres, there is a striking proof, when the action of the heart suffers merely a temporary disturbance: the phenomena resulting from this sympathy have not escaped the dramatist when delineating the effects of a sudden mental emotion :—

> "A dizzy mist that swims before my sight,
> A singing in mine ears: 'tis strange enough,
> 'Tis slight, 'tis nothing worth, 'tis gone already."

Joanna Baillie.

Neither is the influence of a temporary disturbance in the heart's action less remarkable on the spinal cord; illustrations of which are afforded in the trembling from fear, and in the involuntary movements of the limbs, which so frequently accompany a state of violent mental excitement.

Functions of the nervous system depend upon those of the heart.

As the circulation of the blood in the cerebro-spinal system depends upon the function of the heart, the condition of that system must necessarily be modified by every change in the heart's action. Our endeavours to investigate the true nature of these phenomena are, therefore, of essential importance in prosecuting inquiries into the diseases of the heart; as I think it will appear that the aberrations to which *sleep*, and the various conditions of the intellectual powers, during *wakefulness*, are liable, can all be shown to be the effects of modifications in the functions of the heart; and that these changes in the nervous system afford an important addition to the catalogue of *symptoms* in the heart's diseases, though little attention has hitherto been paid to them by pathologists.

Sleep and wakefulness.

Sleep.

Of all the conditions of the cerebro-spinal system depending upon the heart, one of the most remarkable is that of sleep:

> "The death of each day's life"—

is a condition of that system, which, I will endeavour to point out, is wholly dependent on the state of the circulation in the brain, and is subject to various modifications, when the functions of the heart are changed.

Natural and perfect sleep is one of the most essential functions of animal life; a state in which a great part of our existence is spent. The mind, like the body, has its seasons of activity and repose; and whether one or more of the intellectual powers be weary, these require rest, like every other part of our physical frame.

> " Again to that accustom'd couch must creep,
> Where joy subsides, and sorrow sighs to sleep,—
> And man, o'er-labour'd with his being's strife,
> Shrinks to that sweet forgetfulness of life."

Byron.

Conflicting theories of sleep.

An inquiry into the nature of sleep is the more important, when investigating the phenomena of the circulation, as some vague hypotheses and untenable theories have been entertained on this subject by eminent physiologists. Until the errors of such discrepant opinions be pointed out, and the true nature of sleep be revealed, the connexion between the heart and the brain, in the disordered states of the circulation, cannot possibly be understood.[1]

Illustrated by the phenomena of waking;

In order to explain the influence of the *musculo-cardiac* function on the circulation, I selected the phenomena which are developed in the *act of waking*, as an excellent illustration of that function of the muscular system; and I have likewise endeavoured to explain how all the movements of the body which are made when waking from sleep, such as yawning and stretching the limbs, have the effect of increasing the vigour of the heart, and, consequently, of increasing the impetus of the vital stream in the vessels of the whole cerebro-spinal system.

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[1] Opinions of some authors on the proximate cause of Sleep:—"*Sleep,*" observes Haller, "arises either from a simple absence, deficiency and immobility of the spirits, or from compression of the nerves; and always from the motion of the spirits through the brain being impeded."—Haller's *Physiology.*

"It has been attempted to show the proximate cause of sleep. Some have said that it depends on the collapse of the laminæ of the cerebellum, which, as they conceive, are in a state of erection during waking; and they argue from the experiment in which, by compressing the cerebellum of a living animal, sleep is immediately brought on. This sleep, like that produced by compression of any other part of the cerebral mass, is really a state of disease, and no more natural than apoplexy. Others, conceiving sleep, no doubt, analogous to this affection, ascribe it to the collection of the humours upon the brain during waking. This organ, say they, compressed by the blood which obstructs its vessels, falls into a state of real stupor,—an opinion as unsupported as the other. As long as the humours flow in abundance towards the brain, they keep up in it an excitement which is altogether unfavourable to sleep. Do we not know, that it is enough that the brain be strongly occupied by its thoughts, or vividly affected in any way, to repel sleep? Coffee, spirituous liquors, in small quantities, will produce sleeplessness, by exciting the force of the circulation, and determining towards the brain a more considerable afflux of blood. All, on the other hand, that may divert this fluid towards another organ, as copious bleedings, pediluvium, purges, digestion, copulation, severe cold, or whatever diminishes the force with which it is driven towards it, as inebriation, general debility, tends powerfully to promote sleep. In like manner, it is observed, that while it lasts, the cerebral mass collapses,—a sign that the flow of blood into it is remarkably lessened."—Richerand's *Elements of Physiology.*

"In proportion as these phenomena proceed (the relaxation of the muscular system) the respiration becomes slower and more deep; the circulation diminishes; *the blood proceeds in great quantity to the head:* animal heat sinks; the different secretions become less abundant."—Majendie's *Physiology.*

"The tendency to sleep is evidently promoted in different cases by causes which *increase the flow of* blood towards the head, and its impetus on the brain, especially if they be not such as to excite at the same time the activity of the mind.'

Again, "on the other hand, the action of the heart becomes somewhat slower, and perhaps somewhat weaker during sleep."—Alison's *Physiology.*

and by the phenomena which precede sleep.

No less interesting, or more strikingly illustrative of the changes of the circulation in the cerebro-spinal system produced by the *musculo-cardiac* function, are those phenomena which take place in a person *falling asleep;* these form a powerful contrast in their effects upon the brain and spinal cord to those which are manifested when a person is in the act of waking. It will be shown, that the phenomena which usher in sleep, all combine to *diminish* the force of the heart's action, and, consequently, to diminish the supply of the arterial blood to the brain; and that all those phenomena which accompany waking contribute to invigorate the heart, and, consequently, to *increase* the flow of the arterial blood to the nervous system.

These diminish the circulation.

Phenomena preceding sleep enumerated.

When a person is about to fall asleep, whether impelled from mental fatigue, from bodily exhaustion, or from habit, he prepares himself to pass into that state, by bending his limbs, placing them in those attitudes, and seeking such a position for his whole physical frame, as will relax the greatest possible number of the voluntary muscles. He loosens, or altogether removes, his garments, so that they shall not cause any obstruction to the circulation of the blood in the extremities. He likewise endeavours to prevent the organs of hearing being excited by selecting a place of tranquillity; and he closes the eyelids to exclude the organs of vision from the excitement of external objects, as well as from the stimulus of light. "Sleep, which shuns the light, embraces darkness, and they lie down together most lovingly under the sceptre of midnight."

Relaxation of the voluntary muscles.

Abstraction of noise and light.

Macnish *on Sleep*.

Illustrated by the phenomena of waking.

The changes which take place in the brain and in the organs of circulation when we pass from sleep to wakefulness are no less important in pointing out the true nature of this function, than those phenomena by which it is accompanied.

Instead of means being resorted to by the economy to diminish the vigour of the circulation, as it does on the approach of sleep, See page 76.

changes of a perfectly opposite character take place on the approach of the waking state—changes which have been already shown to *increase* the vigour of the heart. The muscular system, which, during sleep, had been in a state of complete repose, is now thrown into action, the position of the trunk of the body is changed, and the limbs are stretched. In the same manner as when on the approach of sleep one organ of the brain slumbers after another, so on waking one organ is awaked after another, a certain time being required before all the intellectual powers are revived ; but if we are awoke very suddenly out of a profound sleep, " our ideas are exceedingly confused, and it is some time before we can be made to comprehend what is said to us."

Organs of the brain awake in succession.

Macnish.

Sleep not produced suddenly.

When passing from the waking state to sleep, in the same manner as when passing from sleep to waking, the change is not made instantaneously, but requires some length of time. " Thus," observes the illustrious Cullen, " when a person is falling asleep, the sensibility is gradually diminished ; so that, although some degree of sleep has come on, slight impressions will excite sensation, and bring back excitement which the same, or even stronger, impressions will be inefficient to produce when the state of sleep has continued long, and is, as we say, more complete. In some members it fails sooner than in others, and it is some time before it becomes general and considerable over the whole."

The circumstance, that the brain " does not all at once glide into repose, but that its different organs are successively thrown into that state—one dropping asleep, then another, then a third, until the whole are locked up in the fetters of slumber," offers an incontrovertible testimony that the brain is composed of a plurality of organs.

Macnish.

Those phenomena which usher in sleep and waking are also manifested in *dreaming :* and in all the varieties of imperfect sleep, as well as in diseases of the heart, it will be found that, whenever the action of the heart is disturbed, it is not the whole nervous system which is influenced by the altered circulation, but only one or more portions of the brain or spinal cord.

Circulation equalized during sleep.

Reviewing all these phenomena which usher in sleep, we accordingly find that, during calm and perfect slumber, there is a considerable *diminution* in the force of the heart's action, as well as a diminution in the frequency of its pulsations, and, consequently, there must be a less quantity of arterial blood ejected by each contraction of the left heart. All parts of the body will now receive blood in proportion to the size of the arteries distributed upon them: none of those differences and irregularities of its distribution to particular organs ever happen during perfect sleep which are so constantly taking place in the waking state, more especially those changes which are caused by the varied functions of the respiratory, digestive, and muscular systems, as well as by mental emotions. So enfeebled, indeed, are the powers of the organs of organic life during sleep, from the diminished vigour of the circulation, that those diseases the chief character of which is marked by great debility, such as *petechiæ* and gangrene, usually appear first during sleep.

To these changes in the general circulation must necessarily succeed corresponding changes in the sensorium: when sleep is perfect, all the cerebral functions cease. "In sleep there is a suspension of animal life, and during its continuance man is under the influence of organic life alone; it is a temporary metaphysical death, though not an organic one." Bichat.

Sleep the effect of a diminished quantity of arterial blood in the brain;

As all the phenomena which precede sleep must, it is evident, materially contribute to equalize the supply of the vital fluid to every organ, and to every part of the body, they must undoubtedly have also the effect of *diminishing*, in a special manner, the supply of the systemic blood to the brain; and, consequently, the various modifications both of sleep and wakefulness can be most satisfactorily explained by contemplating the corresponding changes which take place in the velocity of the current of the blood in the cerebro-spinal system. As all these modifications of sleep must depend upon changes in the action of the central organ of the circulation, so will each of them become an important sign of the state of the heart, both in health and in disease. Indeed, I may here remark, that there are no morbid phenomena connected with the cerebro-spinal system which, when viewed conjointly with those manifested in the other systems of the economy, afford more unequivocal symptoms in the disorders of the heart, than the various modifications of sleep.

its modifications are important symptoms.

Sleep—how disturbed or promoted.

This account, which I have given of the nature of sleep, meets with an additional confirmation, by reviewing those causes which disturb, or altogether prevent sleep, and likewise those causes by which it is promoted.

The means which are usually resorted to for *preventing* sleep, such as drinking strong tea or coffee, increase the heart's action, and will, consequently, increase the supply of arterial blood to the brain; whilst those which are employed to *promote* sleep are such as tend to subdue the action of the heart, and thus diminish the quantity of arterial blood which is sent to the head. The practice of immersing the feet in warm water to which has been added a stimulating ingredient, such as vinegar, mustard, or common salt, disposes to sleep, by increasing the supply of blood to the extremities, and diminishing the quantity within the head. Sponging the body with diluted vinegar, spirits, or with salt water, by producing a glow on the skin, also relieves the internal organs of a certain quantity of blood. Taking fluids into the stomach disposes to sleep, by diverting blood to that organ.

When the intellectual powers have been kept in a state of excitement, the heart's action is often so much increased that sleep is interrupted, if not altogether prevented; and, therefore, instead of endeavouring to sleep immediately after any active mental employment, if the body be kept for a while in a state of repose, the excited vascular system will be calmed and tranquillized, and sleep ensue. This effect of mental excitement is remarkable even in children; as it may be observed, that when a child falls asleep immediately after any unusual excitement, its sleep is generally disturbed and unrefreshing. The judicious nurse, therefore, allows the excited system to be tranquillized before she permits the child to fall asleep.

Causes of stupor.

Contrasted with watchfulness or disturbed sleep, is *stupor*, or an unnatural disposition to sleep—a state caused by a very different condition of the circulation in the brain to that which has just been described. In place of an increased supply of arterial blood—the cause of intellectual excitement—there is, in stupor, a congestion of venous blood within the head, a state wherein the veins are preternaturally distended, analogous to that congestion so frequently occurring in the veins of other organs, particularly in those of the abdominal viscera.

The sleep of disease.

Sleep is liable to other disturbances, most of which appear to depend either directly or indirectly on the state of the circulation in the brain; the phenomena of which are, however, very different from the state of excitement caused by an increased supply of arterial blood, or from the stupor produced by venous congestion.

Like other functions of the economy, sleep may be either natural or diseased, and, as the various changes to which it is liable arise from changes in the circulation, its different conditions will afford, as has been already said, important *symptoms* in many diseases of the heart,—irregularities in the venous circulation within the head being referable to those of the *right*, and alterations in the arterial circulation indicating changes in the *left* heart.

THE DISEASES OF THE HEART.

CHAPTER XII.

THE DISEASES OF THE HEART IN GENERAL.

Arrangement of the subject; the pathological doctrines established by induction; phenomena of the healthy circulation; importance of a knowledge of healthy structure; utility of an inquiry into the functional diseases of the heart; frequency of diseases of the heart; state of the heart's pulse long neglected by pathologists; attention paid to it by the Chinese.

Arrangement of the subject.

Before entering upon the consideration of the particular diseases of the heart, I propose to give a general view of their various *phenomena*; of the *causes* which produce them; of the *symptoms* by which they are accompanied; of the principles on which their *treatment* should be conducted; and of their *classification*.

By adopting this plan, it has appeared to me that the materials which I have collected, may be greatly condensed, and that endless repetitions will be prevented,—repetitions which would have been unavoidable, had I attempted, when treating of each disease, to enter into minute details; whereas, by first giving a *general* view of the nature of all the diseases of the heart, and of the means best adapted for their treatment, such general views will be found applicable to particular maladies. Thus, instead of being obliged to repeat, when treating of each disease, those rules which ought to guide us in the administration of any particular class of remedies, it will only be necessary to refer to the general observations which have been made. Thus, in the employment of blood-letting, the observations on the indications for adopting it; the extent to which it ought to be employed; when local is to be preferred to general blood-letting, are all equally applicable to various affections of the heart, and need only be referred to, when treating of the disease to which that remedy is applicable. The same remark applies to purgatives, sudorifics, and, above all, as we shall find, to the *cardiac* class of remedies.

The physiological doctrines have been established by induction, and likewise the pathological.

The views which have been given of some important phenomena connected with the circulation, may be considered as the basis of the pathological doctrines which I will now endeavour to establish. In the same manner, therefore, as I have pursued these investigations, by making inductions from observations, the accuracy of which has been universally admitted, the subsequent *pathological* researches have been conducted,—collecting and arranging facts, and drawing legitimate conclusions from them, in order to elucidate and explain various morbid phenomena.

Phenomena of the healthy circulation explained.

I have already mentioned, that, when seeking for an explanation of certain *symptoms*, which are often present in those suffering from diseases of the heart, that my attention was first directed in a particular manner to endeavour to explain these and other phenomena connected with the circulation in the thoracic viscera.

Pursuing this inquiry, I have pointed out, that there are *three* distinct functions performed by the organs of circulation and respiration, conjointly with those of active motion; functions by which we are enabled to explain certain phenomena in the healthy state of the system,—a knowledge of these will not only elucidate the nature of many disorders, but also point out a class of *symptoms* which will, I am confident, afford essential diagnostic signs in diseases of the heart.

These elucidate its pathology.

Thus the function, which I havedenominated the *musculo-cardiac*, and which is employed by the economy for increasing the quantity of blood within the heart, I will now endeavour to show, performs an essential share in the diseased, as well as in the healthy condition of the organs of circulation. It will be also shown that the other two functions are of no less importance: the *pulmo-cardiac* function, which regulates the circulation in the lungs and heart, and the *veno-pulmonary* function, which receives the superabundant venous blood that cannot find admission into the pulmonic heart.—It is to these functions of the muscles, of the lungs, and of the venous system, that we must always refer in order to explain the various changes, which are almost constantly taking place in the distribution of the blood whenever the functions of the heart are disturbed.

Importance of a knowledge of the healthy structure.

How could it, indeed, have been expected that the phenomena of the numerous disorders to which the heart is subject, could have been understood until the precise nature of its healthy structure and functions had been pointed out? It is only by an acquaintance with the natural phenomena of the functions of different organs of the body, that any satisfactory explanation can be given of their morbid conditions; whilst, at the same time, it ought to be recollected, that both the healthy structure and functions of organs, have been often revealed by observations made on their diseases.

I may also take this opportunity of impressing, more especially upon the junior members of the profession, the great importance to be derived, both from anatomy and physiology, in prosecuting all pathological researches, and the constant reference which should be made both to the natural structure and functions of organs, whenever we attempt to explore their changes from disease. "The nature of the body is the principal or foundation on which all the reasoning of physic is built." Here, too, I may allude to the impediment which has so often obstructed the progress of medical science from the attempts that have too often been made to divide it into separate branches: such unphilosophical and narrowed views have greatly contributed to lower in public estimation, and depreciate the value of, a profession, the comprehensive knowledge of which is calculated to confer the greatest blessings on the human race.

Hippocrates.

The functional diseases of the heart;

Though, as I have said, the morbid changes of the different tissues which compose the heart, or, in other words, its *organic* diseases, have already been rigidly investigated by many distinguished pathologists; yet of those disorders wherein there is no apparent change of structure, and where only the functions of the central organ of the circulation are disturbed, little has

their importance.

been noticed by those who have professedly treated of the diseases of this important organ. Now one of the objects which I am desirous to accomplish in this work, is to elucidate and explain these *functional* diseases, and to point out the treatment by which they may be relieved; being fully persuaded that the functions of the heart are liable to various disorders, the knowledge of which will be of essential importance in the healing art. And though it is a too general opinion that the organic diseases of the heart are not remediable,[1] yet the numerous ailments in which there is merely some functional disturbance, I may with confidence affirm, are, most of them, and certainly as much as the diseases of any other organ, within the control of medical treatment.

Their frequency.

Disorders of the heart are, I am convinced, more frequent than is usually supposed. If we may venture to draw any general conclusions from all that has been said in medical writings as regards the *frequency* of these diseases, it would appear that they were not so very common; those only having been minutely described in which the symptoms had acquired an aggravated character, and some of the heart's structures had been materially changed. But when we take into consideration all its functional diseases, and, likewise, the fact that there is scarcely any serious malady of the whole frame in which, during some period of its duration, the heart is not more or less affected, it must be admitted that such maladies are much more frequent than is usually supposed.

> " There is an order
> Of mortals on the earth who do become
> Old in their youth, and die ere middle age,
> Without the violence of warlike death;
> Some perishing of pleasure—some of study—
> Some worn with toil—some of mere weariness—
> Some of disease, and some insanity—
> *And some of wither'd or of broken hearts;*
> *For this last is a malady which slays*
> *More than are number'd in the list of fate;*
> *Taking all shapes, and bearing many names."*

Byron.

That disturbances in the heart's functions are very frequent, there is surely no need of any other evidence than a knowledge of the numerous changes which take place in the arterial pulse; such changes always indicating some corresponding alteration in the movements of the heart. It is, therefore, remarkable that, while the attention of most pathological inquirers has been assiduously directed to the detection of changes in the *arterial pulse* when investigating every disease of the body, yet that they have seldom deemed it necessary to examine into the condition of the heart itself, although they must have been aware, at the same time, that the arterial pulse is felt for no other purpose than to acquire information on the state of the central organ of the circulation. Indeed, I have a strong conviction that the habit of examining the arterial pulse, in place of the beats of the heart, has been a fruitful source of error in the practice of medicine. It may not be unworthy of notice, as a curious fact, that the Chinese, of whose progress in medical science we know so little, when exploring the condition of a patient, place the hand or ear on the region of the heart, besides feeling the radial pulse.

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[1] "Complaints of the heart ought to be placed among those affections which, having carried patients as near as possible to the grave, may yet be so remedied as to permit of a long existence."—ANDRAL.

The heart's pulse long neglected;

attention paid to it by the Chinese.

The various interruptions which the heart's action must sustain from the habits and passions of mankind, render it not surprising that, from the influence of the blood on every organ, the heart should not only be itself the seat of many diseases, but also that it should become the exciting cause of disturbances in other organs. Every movement of the body—every mental excitement—every disorder in the respiratory and digestive apparatus—every disturbance of the nervous system, causes, as I have already observed, some alteration in the action of the heart. The various irregularities and unequal distribution of the blood, which inevitably result from these changes, cannot fail, ultimately, to create derangement of structure, as well as disturb the function of those organs whose circulation has been disordered.

They excite disease in other organs.

"Few children perish from diseases of the heart; but the proportion of the old who suffer from diseases of the organs of circulation, is very great. It seldom happens that the heart and large blood-vessels, in those who are far advanced in years, are perfectly healthy."

Andral

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Diseases of the heart confined to mankind.

Diseases of the heart may be considered almost exclusively confined to the human race. In domestic animals, which are much exposed to inordinate muscular exertions, such as the horse, the heart is frequently found diseased; but in wild animals, diseases of the vascular system have seldom or never been observed.

CHAPTER XIII.

THE PHENOMENA AND CAUSES OF THE DISEASES OF THE HEART.

The differences in the quantity of the blood; differences in the capacity of the heart's cavities; differences in the structure and functions of the pulmonic and systemic hearts; cardiac congestion; its nature, causes, and phenomena; disorders of the heart from a diminution of blood; from atmospheric changes; from alterations in the qualities of the blood.

Changes in the quantity of blood in the heart.

Of the various causes of diseases of the heart, by far the most frequent, though hitherto the most unsatisfactorily explained, are those in which there takes place a change in the *quantity* of blood within the cavities of the heart. To this condition of the central organ of the circulation our inquiries will be particularly directed, as it is one which either precedes or accompanies almost every disease of the heart, and, above all, as it is a morbid condition which is quite within the reach of medical treatment.

Cardiac congestion defined;

When, from whatever cause, an increase in the quantity of blood in the heart's cavities has taken place, beyond a certain limit, and when they have no longer the power to empty themselves sufficiently, the heart may then be considered to be in a state of *congestion.* The common expressions of a "full heart," or of a "heart ready to burst," are pathologically correct.

its causes.

Congestion of the heart may be produced either from the exit of the arterial blood being impeded; the influx of the venous blood accelerated; or from the muscular powers of the heart being incapable of sufficiently emptying the different cavities.

On all occasions when there is a temporary increase in the *influx* of the venous blood into the right heart, and at the same time a diminished *efflux* of the arterial blood from the left heart, the pulmonary vessels, as has been shown, possess the power of receiving a portion of such superabundant blood, as cannot gain

See p. 88.

entrance into the cavities of both hearts; but when the accumulation becomes so great, that no more blood can be admitted even into the pulmonary vessels, without over-distending them to such a degree as to prevent the bronchi from receiving the necessary quantity of air for oxygenating the blood, then such superabundant blood stagnates in the venous system, and remains there as in a reservoir, until the excited heart is able to receive and restore it into the general circulation.

Illustrated by experiments on living animals;

The condition of the heart, when in a state of congestion, is distinctly shown by experiments that have been made on living animals, and also by observations on the varied phenomena of disease.

(*Lectures on the Vascular System*, by James Wilson, 1819)

On opening the thorax of animals that had been hanged or drowned, Coleman found "the right auricle and ventricle completely gorged with blood; and no contraction of the auricle took place, on the application of a stimulus, until a vein was opened, and some blood allowed to escape; in a few months after which, on the stimulus being again applied, the auricle contracted."

(See *Edinburgh Med. and Chir. Journal*, 1836)

In numerous experiments on animals which were hanged or drowned, Reid found that there was congestion in the pulmonic heart, and that venesection, soon after the heart ceased to beat, at once relieved the pulmonic ventricle and excited its pulsations. It is perfectly well known that horses, when they have been so severely galloped as to fall down apparently lifeless, are speedily recovered by the abstraction of some blood from a vein.

and by the phenomena of disease.

The phenomena of a congested heart are no less forcibly illustrated in the human body.

Case.

A lady, much agitated, walked a considerable distance more quickly than usual. Her breathing became so oppressed, and the beatings of the heart so violent, that she was taken into an adjacent dwelling, where she was bled in the arm, by which treatment she obtained immediate relief.

Even an artificial state of congestion has been contrived for the purpose of simulating disease of the heart. Of this two remarkable examples are narrated of French conscripts. In one of them the congestion was caused by tying a thin cord round the neck so tightly as to be concealed by the folds of the skin; in the other a ligature was drawn very tightly round the upper part of each arm. In both cases the impulse of the heart was much increased; the countenance became purple and swollen; these symptoms disappeared on the removal of the ligatures.

Diction. des Sciences Méd. Cases.

A woman, who was hanged until she was supposed to be lifeless, recovered after a copious venesection.

There are also many instances of persons with organic affections of the heart who have expired from an over-distention of its cavities, caused by some violent exertion.

A gentleman with a diseased heart ran quickly to overtake a coach, and, almost immediately after getting into it, he expired. A clergyman, who had long suffered from a disordered circulation, when in the pulpit, and passionately exhorting his congregation, he dropped down lifeless!

Analogy of cardiac congestion to a retention of urine.

The effects of congestion of the heart may not be inaptly compared to what is observed of other muscular organs, when exposed to an excess of their natural stimulus, and at the same time are over-distended, as in a retention of the urine in the bladder. The urine, which is the natural stimulus of that viscus, if collected in a moderate quantity, causes it to contract; but, if the quantity be increased beyond a certain limit, the power of evacuation is then diminished. There are persons, in whom the contractile power of the bladder has been so much enfeebled, from some accidental over-distention, that they have long afterwards been able to expel only a small portion of its contents, a certain quantity always remaining in the bladder which could only be removed by a catheter.

Both treated on the same principle.

The mode of relieving both these organs, the heart and the urinary bladder, when in a state of over-distention, is also effected chiefly on the same principle; as by evacuating the bladder by artificial means, its muscular coat is afterwards enabled to perform its functions, and, by abstracting some blood by venesection, the over-distended cavities of the heart are enabled afterwards to avert any undue accumulation of blood.

The analogy incomplete.

Though this analogy of a congestion of blood in the heart to a retention of urine be true, the heart being considered simply as a muscular reservoir, there are other circumstances and other phenomena to be explained, when this organ is in a congested state; all of which arise from the more complicated mechanism and peculiar functions of the heart, not only in receiving, but also in mixing the venous blood; in giving a special direction to its different currents; and in ejecting the systemic blood into the arteries.

Phenomena of cardiac congestion explained.

But, as I have before said, whenever it happens that a disturbance in the circulation, caused by an increase of the blood within the heart, becomes such as that it cannot be relieved by those means possessed by the system, or, to use the language of the schools, when the powers of the *vis conservatrix naturæ* are insufficient for that purpose, the heart may then be properly said to be in a state of *congestion.*

To cause this condition of the heart, it is clear that, whatever may be the ultimate effect of the *musculo-cardiac function* on the systemic circulation, there cannot be, from the position and structure of the aortic valves, in the first instance, any reflux of the arterial blood into the left ventricle, at least in the healthy state of the organ.

The congestion must commence in the *right* heart, into the auricle of which the stream of venous blood is, from the muscular contractions, poured out with an increased velocity. From the right auricle the venous blood will next pass with an increased impetus into the right ventricle, and thence into the pulmonary artery, in whose branches it will accumulate until the quantity becomes such as the pulmonary vessels cannot receive.

The pulmonary artery being now gorged with blood, none or scarcely any of its contents can, from the mechanism of the valves, regurgitate into the right ventricle, so that when the right ventricle becomes fully distended, and cannot force any more blood into the pulmonary artery, the venous blood must then regurgitate into the right auricle, and stagnate in the venous system.

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The pulmonary arteries being thus distended, the circulation of the blood in the pulmonary capillaries must necessarily be proportionally retarded; so that the velocity of the blood in the pulmonary veins will then be diminished, and there will, at the same time, be a corresponding diminution in the momentum of the systemic blood.

The fatal effects of congestion.

Hitherto I have been considering the condition of the heart, when congestion has not advanced beyond what may be considered its *first* degree; but, when it proceeds further, important changes then take place, both in the circulating and respiratory apparatus—changes which cause those disturbances that create the most alarming symptoms, and which in some instances even prove fatal.

On a former occasion I observed that, by an undue exercise of the *musculo-cardiac function*, serious injuries were sometimes inflicted on the heart's structures; the congestion from such violent muscular efforts causing the valvular apparatus to be lacerated, the *columnæ* to be torn, and in other instances the parietes of the heart and aorta to burst.

Cases.

A man fell from a great height and was taken up lifeless; on examining the body, the pericardium was found gorged with blood, which had escaped through fissures both in the right auricle and ventricle.

Another man fell from a height, upwards of forty feet, and died in an hour. The mediastinum was filled with blood, and there were two fissures at the commencement of the descending aorta, through which the blood had escaped.

A youth playing very eagerly at tennis was suddenly seized with a "reeling" in the head, difficulty of breathing, and syncope. He suddenly expired some years afterwards, having, during the intermediate period, suffered from a disordered state both of the pulmonary and circulating apparatus. It was discovered, that his death had been caused by the bursting of a small *aortic aneurism* within the pericardium, which had doubtless arisen from the over-exertion he made at the beginning of the illness, producing such a degree of congestion as to injure the coats of the aorta.

State of the respiratory organs.

No less severe are the changes which congestion of the heart, caused by violent muscular efforts, sometimes produce on the respiratory apparatus. When the pulmonary vessels are so loaded with blood that there is a considerable diminution in the capacity of the bronchi, the circulation in the pulmonary capillaries becomes extremely languid, or the blood may stagnate, so that, besides a great degree of dyspnœa, or embarrassment in breathing, there is frequently hæmorrhage from the bronchial vessels, which is sometimes so profuse as to cause syncope and even suffocation.

Case.

A lady, when walking through a field, where some cattle were grazing, was pursued by them; the exertion she made to save herself, and the excitement were so great, that a short time afterwards she expectorated a large quantity of blood, and continued to suffer from a disordered circulation for many years.

Case.

Another lady expired during the agony of childbirth; on examining the thorax, the lungs were found throughout gorged with blood.

Similar effects are frequently produced by rowing and running races; persons being often induced, under such circumstances, to make exertions beyond their "condition."

Indeed, the state of the respiratory function in cardiac congestion indicates a corresponding state of the pulmonary circulation, the breathing being quickened consisting of very incomplete expirations and short inspirations, the engorged state of the lungs admitting into the bronchi but a comparatively small quantity of atmospheric air.

The same phenomena are observed in animals. A horse fell down lifeless after a violent gallop; the lungs were found to be completely gorged with blood, so as to resemble liver, whilst the heart's cavities were perfectly empty. In other instances the efforts to respire have been in these animals so great, from the engorgement of the lungs, as to lacerate the diaphragm, and even squeeze some of the abdominal viscera into the thoracic cavity.

Congestion arises from various causes.

Congestion of the heart may also be produced by other causes besides inordinate muscular exertions. The injurious effects of violent mental emotions, the suppression of periodical discharges, changes in the density, temperature, and chemical qualities of the atmosphere as well as the agency of many vegetable and mineral substances, all, as will subsequently be fully explained, disturb the functions of the heart, causing changes in the quantity of its blood. A congested condition of the heart may likewise arise from alterations in the form of its cavities, or of the great vessels emerging from them, or from artificially obstructing an arterial trunk.

Congestion of the Coronary Vessels.

The cavities of the heart having become congested, we are next led to inquire into the state of the circulation of the *coronary vessels*,—the nutrient arteries of the heart itself; for, as has been already shown, the effects of the *musculo-cardiac* function are not only to increase the quantity of blood within the cavities of the heart, but also to increase the flow of blood into all those arteries which are *not* compressed by the contractions of the adjacent muscles. The circumstance that the coronary arteries arise from the aorta on the *distal* side of the semilunar valves renders it evident that these vessels must participate in every change of the circulation of the blood in that part of the aorta. Their orifices being so large, in proportion to the calibre of the vessels, having a trumpet shape, they are thus admirably calculated for receiving both the stream of blood passing directly from the left ventricle into the aorta, during the systole of the ventricle, and also for receiving the retrograde current, when the semilunar valves are closed during the diastole of the left ventricle.

Coronary veins congested.

The circulation in the *coronary veins* will also be more or less influenced by changes in the quantity of blood which is in the heart's cavities, as well as by the congested state of the coronary arteries; as the great coronary vein opens directly into the right auricle, the flow of its blood into the auricle will be impeded in proportion as that cavity is congested.

Pathological inferences.

Such an over-distended state, both of the coronary arteries and veins, must undoubtedly give rise to some of those peculiar symptoms which accompany a congested heart; and it is by no means improbable that, in many cases of cardiac congestion, after the superabundant blood has been removed from the heart's *cavities*, a congestion of the *coronary vessels* may continue, and ultimately cause diseased changes in the muscular, as well as in other tissues of the heart.

Nature of congestion illustrated by

In conclusion, I may briefly recapitulate, that the explanation which has been offered of the condition of the heart, when in a state of congestion, accords with the physiological symptoms accompanying it; with the appearances which have been observed in the congested hearts of living animals, and with the artificial means by which the congestion can be relieved.

the physiological symptoms which accompany congestion;

1*st*, Of the physiological symptoms which accompany congestion, the most striking is an increase in the impulse of the heart, and a corresponding diminution in the force of the arterial pulse,—the *increased* impulse of the heart being caused by the additional effort necessarily made to empty itself of the accumulated blood,—and the *diminution* in the force of the arterial pulse arises from the diminished power of the heart to circulate the blood, with its proper impetus, through the arterial system.

the appearances in living animals, and

2*dly*, When the heart has become congested in animals, from hanging or drowning, the congestion in the cavities of the right heart is very apparent; and when the congestion is such as to impede the action of the heart altogether, the abstraction of some venous blood has the immediate effect of restoring the heart's movements.

the means of relieving it.

3*dly*, The effect of venesection in relieving cardiac congestion is also confirmatory of the explanation which I have now given of this condition of the heart. No sooner is a quantity of blood abstracted from a vein, than the arterial pulse begins to acquire additional *vigour*, and the impulse of the heart to *diminish:* the increased vigour acquired by the heart being always in proportion to the diminished action of the arteries. But if the depletion be carried further, then the vigour both of the arterial and cardiac pulse is lessened, and finally a state of syncope may supervene.

Effects of Changes in the Qualities of the Blood upon the Heart.

Diseases of the heart from changes in the blood;

However much the action of the heart may be changed by differences in the quantity of the blood, to a far greater degree are its functions disturbed by changes in the qualities of the blood, as these changes cause many of the heart's maladies.

The increased action of the heart in fevers, the disturbed state of its functions in chlorotic patients—in those suffering from jaundice, scurvy, and cachectic diseases—in persons whose constitutions have been much debilitated, and likewise in malformations, are all examples of disturbances in the heart caused by changes in the *qualities* of the blood. Such changes in the qualities of the blood are not, however, limited to causing changes in the heart's functions alone, but produce a variety of disturbances in the different organs and systems of organs, more especially in the cerebro-spinal and respiratory systems, as well as in the organs of incretion and of excretion.

in the Asiatic cholera;

The changes of the blood in Asiatic *cholera* affect greatly the action of the heart. The escape of the serous part of it into the alimentary canal, and the extreme thickness of what remains in the veins, render its circulation very difficult, and cause that congestion in the heart, as well as in the portal system, which forms such remarkable features in that fearful malady.

The colour of the venous blood, which is artificially evacuated in *inflammatory* diseases, shows how much the disordered state of the circulation in these ailments depends on the condition of the vital fluid.

The state of the blood itself, as well as the action of the heart, is sometimes changed by violent *mental emotions*, so that the treatment of such cases ought to be conducted with a view to restore the qualities of the blood, as well as to tranquillize the action of the heart.

"It is by the mental emotions of the mother that the blood becomes vitiated, and influences the growth, health, and life of the fœtus. The violent passion of a *nurse* alters the milk in such a manner, that the infant's health is deranged. Anger has such an influence on the saliva, that the bite of enraged animals transmits a poisonous fluid into the wound." (Bichat)

in exanthematous diseases;

Disorders of the heart are also caused by those states of the blood that give rise to the various local inflammatory affections, which so frequently succeed small-pox, measles, scarlatina, and other exanthematous diseases. Changes in the blood are likewise common in persons afflicted with gout and rheumatism. Specific diseases, such as scrofula, scirrhus, fungus hæmatodes, and fungus melanodes, affect likewise, though rarely, the structures of the heart.

in gout and rheumatism, scrofula, &c.;

I have already observed how small a quantity of blood is requisite for the preservation of life. The vital functions would appear to be carried on without any very sensible effect on the general system, when the *qualities* of the blood itself are greatly altered. This is strikingly exemplified in those cases of malformation of the heart, where the arterial and venous bloods are mixed.

from substances mixed with the blood.

Experiments on living animals have shown the remarkable effects which may be produced on the action of the heart, by artificially mixing different substances with the blood.

The effect of injecting common *salt* into the sanguineous system in Asiatic cholera—a disease, as has been already remarked, Stevens on the Blood, 1832.

wherein the blood is greatly changed, and the action of the heart is interrupted from its vitiated qualities, is a striking proof of the influence which changes in the blood cause on the functions of the heart. Magendie injected a pint of tepid *water* into the veins of a hydrophobic patient, who was in a hopeless condition; "his mind, which was in a state of rage and fury, became tranquillized as by enchantment."

Dupuytren.

The fatal effects of the introduction of atmospheric *air* into the cavities of the heart, through a vein, has long been known, and has been frequently employed for destroying horses; but it has only of late years been ascertained, that the accidental entrance of air into the wound of a vein in the neck, made during a surgical operation, causes almost immediate death. The fatal effects, however, are not produced by any change in the qualities of the blood, but probably by the air entering into the right auricle, there acting as an extraneous matter, and causing a mechanical impediment to the circulation of the blood.

Effects of Disturbances of the Nervous System on the Heart.

Heart disordered by the nervous system.

Of all the causes which disturb the functions and create disorders in the heart, there are none more frequent than affections of the *nervous* system.

I have already remarked, that, in the same manner as diseases of the heart cause disorders of the brain and spinal cord, so the affections of the *cerebro-spinal system* are frequently the cause of diseases in the heart. We have a striking proof of diseases of the brain causing disturbances of the heart in apoplexy, and in injuries of the nervous centres,—in all which cases remarkable alterations take place in the heart's functions. Indeed, it seems to me extremely probable that the great bodily pain and the "shock" occasioned by severe accidents, produce their injurious effects by primarily disturbing the functions of the central organ of the circulation, through the medium of the nervous system.

This reciprocal influence of these vital organs depends, however, on two very different causes,—one from the sympathy which subsists between the heart and brain in virtue of the communication of their nerves, and the other from the influence of the blood upon the brain. So that there are two perfectly distinct classes of those affections of the heart which depend on, or which are caused by, disorders of the nervous system.

Effects of a diminution of Blood on the Heart.

Heart disordered from a diminution of blood

The action of the heart is changed by whatever causes a *diminution* in the quantity of its blood; a diminution, however, seldom takes place to such an extent as can properly be said to constitute a permanent disease.

in anæmia.

Disturbances of the heart from a diminution in the quantity of its blood may be observed in those who have suffered from a profuse hæmorrhage, and likewise in persons of an enfeebled constitution, in whom the quantity of the general mass of blood is below the common standard.

Extent to which the elements of life may be diminished.

It is interesting to remark to what an almost inconceivable extent the stream of arterial blood which leaves the heart can be diminished without causing any very considerable effect on the general system; and how even life itself can be in some instances sustained, when either the left auriculo-ventricular or aortic orifice is so much contracted, as to allow only a very small stream of blood to pass through them. It would, indeed, appear that the functions of all the most important organs of the body may be imperfectly performed, or they may be even altogether suspended, without destroying life. Thus the lungs have been often found very extensively disorganized, admitting only a small quantity of air; one hemisphere of the brain has been entirely changed, the liver greatly diminished in bulk; one of the kidneys completely destroyed; the stomach able to digest but a small quantity of food; the bowels constipated for many weeks, and yet such changes may take place without causing serious injury to the general system. So, in like manner, the heart may be able to circulate only a small quantity of blood, or the blood may be greatly vitiated, and yet life will not be extinguished.

Influence of the passions on the heart

The effects of the *passions* on the heart are well known, and allusions to their influence are found in the sacred writings:—"A joyful heart," says Solomon, "causeth good health, but a sorrowful spirit drieth the bones."

Those persons who are of an irritable disposition, or who are of the *nervous temperament*, generally have the action of the heart easily disturbed: an excitable state of mind is a very common symptom of a disordered heart.

may either increase or diminish the action of the heart.

The effects of mental emotions on the circulation are very different according as the mind is excited or depressed by them. In the exhilarating and violent emotions, the force of the heart is increased, but in the depressing passions its power is diminished. These opposite conditions of the heart are marked by corresponding differences in the circulation—the increased circulation being accompanied with a flushed countenance, wakefulness, restlessness, headache, and fever; and the diminution in the heart's action, with a pallid countenance, sleep, coma, and stupor.

It is, indeed, extraordinary to what degree the vital powers appear to be able to support the system by their influence on the heart. "Courage arises out of the consciousness of strength, and a person's strength is in proportion to the activity with which the heart propels the blood towards all the organs." Richerand.

The lives of mariners and soldiers afford innumerable examples of the courageous and the brave undergoing almost incredible fatigue, and overcoming apparently insurmountable privations and difficulties.

Case.

It is told of Mulci Moloc, Emperor of Morocco, that "he was aroused to make extraordinary efforts in the last battle which he fought. Spent with disease and borne on a litter, perceiving his troops to give way, though very nearly in his last agonies, he threw himself out of the litter, rallied his army, and led them on to the charge, which ended in a complete victory to his party! He had no sooner brought his men to the engagement, than, finding himself utterly spent, he was replaced upon the litter, and, laying his finger on his mouth to enjoin secrecy to his officers who stood around him, he died a few moments after in that posture." *Spectator*, No. 349.

No less powerful is the influence of the passions in subjugating disease, of which medical writings afford many examples.

Cases.

An officer, on board Lord Howe's ship, had been for some time confined to his bed from a severe attack of gout; but on the 1st of June, that memorable day, when they were preparing for action, he rose from his bed, fought gallantly, and never afterwards suffered from gout.

"A gouty person who was condemned to lose his head, as they carried him out in order to be executed, received the unexpected news of his pardon, which had so remarkable an effect upon him, that, although he was quite exhausted with the pain of the gout, and had lost the use of every limb, yet he got up on his legs immediately, and walked with remarkable quickness and agility; and he lived many years after without having the least touch of the disorder." Van Swieten.

The effects of mental emotions are likewise strikingly manifested in those, who possess a power within themselves—a peculiarity in their moral constitution, which enables them to withstand, and to recover from wounds and injuries, such as would be fatal to those of an opposite temperament; to resist the ravages of disease, and even to prolong life itself.

Case. An interesting youth, when in the last stage of pulmonary phthisis, expressed a great desire that his life should be protracted, until he became of age, in order that he might dispose of his property. Contrary to the opinion of all around him, he expressed the utmost confidence that his wish would be realized; and he felt as if he had a power within himself to prolong his existence until the wished-for period arrived. The requisite legal deed being prepared and in readiness, when the hour arrived that he reached his twenty-first year, he with a firm hand affixed to it his signature, and almost immediately afterwards expired!

Those too, I have said, who are suffering from disease of a decidedly fatal character, but who have, notwithstanding, full confidence in their ultimate recovery, will often linger, it is well known, under severe bodily affliction much longer than the desponding or hopeless sufferer.

This influence of the mind in sustaining the heart's action is also strikingly exemplified in women during parturition. Though they may often express great fear and apprehension of their approaching confinement, and even augur fatal consequences, yet, when the period arrives, it is very extraordinary to witness the confidence which they suddenly acquire, and the courage with which they endure all the sufferings and agonies of childbirth;

and no sooner does the infant come into the world, than the mother, elated with joy, at once forgets all her past sufferings, and clings with rapture to her child.

The influence temporary or permanent.

The influence of the exciting passions on the heart is not only temporary, but is sometimes so violent as to create a permanent disturbance in the circulation: many instances are recorded by historians, as well as by medical writers, where the action of the heart has been so greatly changed from a violent emotion as suddenly to destroy life. Even joy—which has, when moderate, such a benign influence upon the system—when excessive, has been frequently known to prove fatal.

Fatal effects of the exhilarating passions.

Cases.

A criminal who was condemned to death, on receiving unexpectedly the intelligence of his pardon, suddenly expired.

"A young Russian nobleman was made prisoner by a tribe of Tartars. He was the only son of a fond mother, who, on receiving the intelligence of his captivity, was plunged into the deepest affliction. Having succeeded, after incredible perils and sufferings, in making his escape, he unexpectedly arrived at his mother's abode, and, on entering the room where she was, the shock was so great that she dropped down lifeless!"

> "Her flaw'd heart (alack! too weak
> The conflict to support) 'twixt two extremes of passion,
> *Joy and grief, burst smilingly.*"

Shakspere.

Anger, likewise, causes a great increase, both in the frequency and in the force of the pulsations of the heart, and sometimes to such a degree as to produce fatal congestion. "One of her elder brothers enlisted as a soldier, rose to be captain, and was taken prisoner at Flushing. Anger at disgrace killed him suddenly! He said, 'I could have borne to die in battle, but not in this way;' and he was dead in a moment."

Autobiography of E. Davies.

Effect of the depressing passions on the heart.

Grief.—The effects of the *depressing* passions on the heart present a striking contrast to those which are caused by exhilarating emotions. That vital element, which I have remarked to be so powerful in giving strength and vigour to the circulation, is here wanting, and there is a condition of the heart quite of an opposite character. The capillaries are emptied of their blood, the stream of blood in the arteries has its momentum diminished, and the heart itself becomes congested, palpitating in proportion as it finds difficulty in propelling its contents through the sanguineous system.

Fear has a powerful influence upon the heart's action, and whilst the exciting passions increase the vigour of the circulation, fear diminishes the powers of the heart;—hence the paleness of the cutaneous surface, and the cold and shivering, which accompany terror.

> "I have a faint, cold fear thrills through my veins,
> That almost freezes up the heat of life!"
>
> Shakspere.

So great, indeed, is the influence of fear in diminishing the action of the organs of circulation, that many cases are recorded in which considerable hæmorrhages were arrested by sudden fear:—

"Every being that is feeble is timorous, an inward feeling warning him that he does not possess sufficient strength to resist it." Richerand.

Effects of fear.

Fear and the other depressing passions, perhaps even much more frequently than the exciting emotions, lay the foundation of diseases of the heart.

Cases.

The wife of a respectable farmer suffered some years from an affection of the heart, which was caused by having her sleep often interrupted during several months from the constant dread of incendiaries.

A nurse, whose sleep had been hourly, and often very suddenly interrupted, during some months, suffered from a severe disorder of the heart.

A lady, from the continued fear of shipwreck, to which she was exposed for eight days, and who never slept during that period, had for a considerable time afterwards a disordered action of the heart.

A lady was suddenly informed of a great reverse of fortune: she immediately felt an uneasy sensation in the region of the heart; the heart palpitated so violently, that she was kept awake during the night, and though it is nearly two years since this event took place, she has never ceased to feel her heart beat with unnatural force.

A young man who, from a sudden fright occasioned by the unexpected firing of a cannon which was near him, caused an affection of the heart, which ultimately proved fatal.

Effects of oral depression.

The absence of that moral influence which sustains the heart's action, and fortifies the physical frame to resist injuries and disease, renders them less supportable, and the body more susceptible of contagion. The surgeon has constant opportunities of observing the difference, in the effects of *operations* performed on the timid, and on those who have great courage. I have repeatedly witnessed patients die from operations, whose death was occasioned by excessive fear.

Case.

A youth, before submitting to the operation of lithotomy, took farewell of his mother, and assured her that he should not recover. He expired a few days after the operation, and I could discover no apparent cause for his death.

Equally remarkable are the effects of *wounds* received in the field of battle. The hospitals of a conquered army exhibit a scene of great moral depression; and many of the soldiers die from wounds which did not appear to be of a dangerous character; whilst in the hospitals of the victorious, the wounded not only recover from frightful injuries, but, even in the midst of the most severe bodily suffering, they exhibit gaiety and cheerfulness, entertaining the most perfect confidence in their recovery.

The letter of a surgeon tells us what the wounded men did at Alma. "The courage of a soldier no one has yet truly described. They laugh at pain, and will scarcely submit to die! It is perfectly marvellous this triumph of mind over body. The dying raise themselves from the ground for one cheer more!"

Effects of grief.

Grief.—Sudden grief and long-protracted sorrow are, I am sure, the cause of disorders in the heart in a vast number of individuals. The effects of grief, like those of fear, consist in a diminution of the vigour of the circulation in the arterial and capillary systems, with a corresponding congestion in the heart, and sometimes to such a degree as to produce syncope. The diminution of all the vital powers in a woman, who is subdued by grief, forms a striking contrast to the violent and hurried muscular efforts which are made by a man when he is enraged.

of rage.

Whilst the increased flow of blood and congestion in the head during *rage* have often proved fatal, the diminution in the action of the heart from mental affliction may proceed so far as to extinguish life.

(Case)

A young woman, apparently in perfect health, on receiving unexpectedly the account of her mother's approaching dissolution, fell on the ground lifeless! Many similar cases are on record; and it is not long since the wife of a criminal dropped down dead after bidding her husband a last adieu!

and of sorrow.

Long-protracted *sorrow* has also a powerful influence on the heart, causing, imperceptibly, its congestion, and gradually destroying the vigour of the whole frame.

> "Of grief subdued
> There comes a token like a scorpion's sting;
> Scarce seen, but with fresh bitterness imbued.
> *And slight withal may be the things which bring*
> *Back on the heart the weight which it would fling*
> *Aside for ever.*"
>
> Byron

Cases.

An amiable woman lost suddenly one of her children; her grief was so intense, that she fell into a profound melancholy; she could not weep, seldom spoke, and for several years afterwards she suffered from a disorder of the heart.

A gallant young officer fell at the battle of Waterloo. His father, on receiving the intelligence of his son's fate, was seized with an uneasy feeling in the cardiac region, which never subsided; he died some years afterwards of a disease of the heart.

Stimulants applied to particular nerves also influence the action of the heart.

Effects of odorous substances.

There are some *odorous* substances which cause a diminution of the heart's action, the moment they are brought into contact with the Schneiderian membrane,—an effect which sometimes takes place to such a degree, that the vigour of the circulation is so greatly diminished as to cause syncope.

Case.

An officer in the navy became always faint when a *cat* was in the room; another person always became faint and sick from the smell of cheese.

Some odorous substances increase the action of the heart, hence they are employed to restore vigour to the circulation. Others increase the circulation, the force of which was diminished.

We may daily see cases of syncope relieved by the vapours of *ammonia* applied to the nostrils; and the exhilarating effects of taking *snuff* are well known.

Effects of pain.

The vigour of the heart is diminished by long-continued *pain*, and when that has been sudden, or very severe, such as often happens from accidents, gunshot wounds, or surgical operations, the "shock" is sometimes so great, as to render the impulse scarcely perceptible, or even to diminish the vigour of the heart, to such a degree, as altogether to destroy life. Thus we can explain the great success of operations, when performed on persons under the influence of *chloroform*.

The word *heart* used figuratively.

Many instances will be subsequently mentioned of the baneful influence which the *passions* have on the circulation, and of their being often the cause of permanent and organic diseases of the heart. It must undoubtedly have been this well-known influence of the mind upon the heart, which has led the word "heart" to be figuratively used in common language, as the seat of the moral sentiments.

Fatal effects of passion on a diseased heart.

Cases.

Corvisart.

The effects of the passions on the heart are still more remarkable, when the heart is previously diseased; and so great is their influence, that many persons afflicted with a diseased heart have perished suddenly from some violent mental emotion. Examples, indeed, are not rare, where, on inspecting the bodies of those who have died from sudden passion, that the heart had been found to have been previously diseased. Of this fact the death of John Hunter is a striking example. Having long suffered from a disease of the heart, he expired immediately after great excitement in the board-room of St. George's Hospital. A man perished suddenly in a violent dispute with one of his comrades; after his death, it was discovered that he had a disease of the heart, which must have been of very long duration.

Fatal effects on dramatic performers.

Case.

These effects of violent passion have been so studiously imitated by dramatic performers of excellence, that they are known to have experienced, when upon the stage, all the ill effects which such emotions produce on the circulation when naturally called into action. We are told of an eminent actor on the Irish stage, who had long suffered from a disturbance in the heart, that in performing, under more than usual excitement, the part of *Justice Woodcock*, he had scarcely finished the first lines, CHAP. XIII.

> "I courted a lass that was froward and shy,"

when he fell down in a state of insensibility, and almost immediately expired! We are also told that, while the celebrated actor Palmer was performing the part of the *Stranger*, he became so impassioned, that immediately after reciting, "There is another and a better world," he dropped down lifeless! Case.

CHAPTER XIV.

THE PHENOMENA AND CAUSES OF THE DISEASES OF THE HEART.

The subject continued; disorders of the heart from the influence of the respiratory, the nervous, the digestive, the vascular, the genito-urinary, the cutaneous, and the mucous systems; influence of hereditary diseases.

Effects of Changes in the Respiratory Organs upon the Heart.

Influence of the respiratory organs.

It has been remarked, that, when conducting our inquiries on the diseases of the heart, that we ought to view them in conjunction with those of the lungs. The diseases of these vital organs, like their functions, are so intimately connected, that whatever disturbs the functions of the one, cannot fail to influence those of the other. So that in tracing the *causes* of the diseases of the heart, as well as those of the lungs, it is often no easy matter to discriminate, in which organ the disease had commenced, as diseased lungs will disturb the heart, and a diseased heart will disturb the lungs.

Heart disturbed by disease of the lungs.

A healthy condition of the lungs being absolutely necessary for the due performance of the *pulmo-cardiac function*, any morbid state of the respiratory apparatus, which interrupts the free circulation of the blood through the pulmonary capillaries, or which prevents the lungs from oxygenating the blood, must cause some derangement in the action of the heart. This is one reason why diseases of the lungs create a much greater disturbance in the function of the central organ of the circulation, than diseases of the same kind, and of equal extent, cause in other organs. The effect of a less quantity of blood being circulated through the lungs, when a portion of them is disorganized, will in a similar manner influence the systemic circulation. The diminished quantity of blood circulating within the thorax accounts for the pathological fact, that the hearts of those who perish from pulmonary phthisis are usually of very small bulk.

When noticing the reciprocal influence of the respiratory and circulating organs, I mentioned the remarkable changes which modifications in respiration are capable of producing on the action of the heart, and how much the function of circulation depended upon the integrity of the lungs; so that it may be rationally anticipated that diseases of the lungs will, in like manner, be the cause of disturbances in the heart. Thus may be explained, how relief is often obtained in the more severe cases of cough by the application of leeches to the cardiac region; and likewise how the cough is mitigated by the use of nauseating doses of antimony. Indeed, it must happen, that in all those diseases where changes have taken place in the structure of the lungs, the derangement which these changes produce in the pulmonary circulation cannot fail to exert more or less influence on the functions of the heart. See page 99.

There are also diseases of the lungs which produce a considerable influence on the action of the heart. In *hooping-cough*, it often happens that, from the interrupted circulation in the pulmonary capillaries, the heart becomes congested.

Violent exertions of the pulmonary apparatus, such as are sometimes made in *crying*, *singing*, *public speaking*, and *playing on wind instruments*, have all been known to cause diseases of the heart. The movements of the chest, in *weeping*, *hiccup*, and *vomiting*, have likewise a great influence on the heart's functions. I have shown that all these *instinctive acts*, employed by the economy, in the healthy condition of the body, are to assist in restoring the balance of the circulation when it has been temporarily disturbed.

Now, it not unfrequently happens, that, if any of these acts be continued beyond a certain limit, they produce pernicious effects on the heart's action. Immoderate fits of *laughter*, I have already said, frequently cause hysteria, and even severe convulsions; which have in some instances been known to proceed to such a degree as to prove fatal. *Weeping* and *crying*, when they are long continued, also greatly disturb the circulation.

On the other hand, as will be hereafter pointed out, each of these several instinctive acts often accompany diseases of the heart, and are resorted to by the *vis medicatrix*, in the same manner as they are employed by the *vis conservatrix*, to relieve disturbances in the circulation, which are constantly taking place in health.

Effects of inspiring certain substances.

The action of the heart suffers various derangements from substances which are imbibed by the lungs during respiration; and some medicines, when exhibited in a *gaseous* form, can be inhaled and conveyed to the blood in the pulmonary capillaries. Thus *ether* and *chloroform* are first absorbed by the lungs, and, when mixed with the blood, cause remarkable effects upon the cerebro-spinal system, especially on the *sensory* column of the spinal cord.

The flushing of the face, the great mental excitement, or even aberrations of intellect, produced by inhaling the *nitrous oxide gas*, afford also a remarkable instance of a disturbance in the action of the heart from chemical agents brought in contact with the mucous surface of the bronchi; as most noxious gases probably cause deleterious effects by their influence on the heart.

Effects of Changes on the State of the Atmosphere on the Heart.

Heart disturbed from descending below the surface of the earth;

Alterations in the state of the atmosphere cause disturbances in the functions of the heart; these may arise either from changes in the *density*, *temperature*, or *chemical* qualities of the air.

A disturbance in the heart's action is manifested, when a person *descends* far below the surface of the earth, such as into a deep mine; the weight of the atmosphere, from its undue pressure on the bronchi and exterior of the body, interrupts the functions, and produces congestion of the respiratory and circulating organs.

from ascending a great height;

The effects which are produced on the heart and lungs by *ascending* high above the surface of the earth, were supposed to be caused by the expanded air containing a less proportion of the materials requisite for the oxygenation of the blood, until the matter was lately put at rest by the testimony of persons who had ascended in a balloon much higher than the highest European mountain. Their breathing was in no manner quickened—a proof that the rapidity of the circulation and respiration on ascending a mountain depends not on the rarefaction of the atmospheric air, but on the effects of the excessive muscular exertion which is required to make the effort.

That this difficulty in breathing, which is experienced when ascending a mountain, does not arise from the state of the atmosphere, but from the excessive muscular exertion which is necessarily made to accomplish the ascent, is also distinctly shown by the testimony of many travellers, all of whom state, that when they ascended a mountain on horseback, or when they were in a state of repose upon the most lofty mountains, their breathing was perfectly natural. It is also known that persons born in regions twelve thousand feet above the level of the sea, do not suffer any inconvenience from the rarefied atmosphere in which they dwell.[1]

Effects of changes of temperature.

The action of the heart undergoes also considerable modifications from the changes in the *temperature* of the atmosphere; these changes may disturb the functions of the heart, either by their influence on the cutaneous, or on the gastro-pulmonary surface.

Effects of heat,

The exposure of the body to a *warm* temperature not only increases the heart's action, by exciting the nervous system, but also, by causing an expansion of the mass of blood, it increases the vigour of the circulation.

Those who are suffering from some affections of the heart, it may be often observed, have the symptoms severe, in warm weather, or when residing in a warm climate. I have frequently known persons, who were supposed to have some pulmonary disease, but in whom the heart was primarily affected, to have their ailments increased by residing in a warm climate, though such a climate is beneficial to those who are suffering from diseased lungs. However, it must be observed that those persons whose circulation is languid, suffer much in cold weather, whilst a warm climate has the effect of invigorating the heart.

and the different states of the atmosphere.

The various conditions of the mind, and the degrees of intellectual energy, which many persons experience in different states of the atmosphere, depend greatly, I am persuaded, if not altogether, on the influence which these have on the circulation.

Some of the effects of the different states of the atmosphere upon the heart, appear to depend greatly on the influence of electrity, whilst others seem to arise from causes of which we are unable to give any satisfactory explanation.

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[1] *Histoire Anatomique et Physiologique*, etc. Par Birchêt. Paris, 1836.

"In the comparative analysis of the air on the Alps and in the marshes of Lombardy, there was found in each the same quantity of oxygen; and yet those persons who breathe the former enjoy robust health, whilst the inhabitants of the marshy plains are pale, emaciated, and habitually lead a languid existence."

Richerand.

Effects of cold on the heart,

A great disturbance of the heart may be also caused by the application of *cold*, either to the cutaneous, or to the gastro-pulmonary mucous surface.

when applied to the cutaneous surface.

The influence of exposing the surface of the body to a cold atmosphere, and of breathing cold air, on the action of the heart, are well known; the change, which is thus produced in the balance of the circulation, is proved by the effect of cold when applied to the feet in preventing sleep, and in causing headache, and also by the powerful influence which warming the legs and feet have—the *pediluvium* and the *maniluvium*—in promoting sleep, and in relieving those headaches which are accompanied with coldness of the limbs.

The pernicious effects of cold, when applied to the skin, on the organs of circulation, often cause general fever, and also local pains, which have the character of muscular rheumatism.

Rationale of these effects illustrated

Severe effects of cold on the cutaneous surface sometimes arise from sleeping in a cold and damp bed; the cold producing in such cases a great diminution in the circulation of the cutaneous capillaries, and a corresponding congestion in the interior of the body, especially within the heart. Hence the good effects of artificial vomiting, in this state of the system, are derived from the influence which the act of vomiting has in restoring the disturbed condition of the circulation.

by emetics.

Case.

A gentleman when travelling was put into a bed which felt so cold and damp that he was induced to lie between the blankets. On the following morning he experienced a sensation of cold throughout his whole body, and likewise a severe pain in the back of the neck and head, which he attributed to the coldness of the pillow. These symptoms continued unabated for nine days after the commencement of his illness. He then complained of great tenderness of the scalp and back of the neck, and said that he had never felt warm, notwithstanding the temperate state of the weather, since he had received the chill. The radial pulse was small and contracted, but the cardiac pulse was vigorous. The exhibition of an *emetic*, and one full dose of calomel, a few hours afterwards, had the almost immediate effect of restoring the balance of the circulation; causing heat and moisture on the skin, and completely alleviating the local pain.

The condition of the heart and capillaries in the cold stage of *ague*, has a striking analogy to that state of the heart to which I have now alluded; and the operation of an emetic in that disease—a remedy the efficacy of which is so universally acknowledged—produces its beneficial effects on similar principles. "It is, indeed, probable," observes Cullen, "that the *vomiting* which takes place during the cold stages of fevers is one of the means employed by Nature for restoring the determination to the surface of the body."

Effect of blood-letting in ague,

In the same manner may be explained how benefit is derived during the cold stage of ague by venesection—a practice employed by the late ingenious Dr. Mackintosh. The abstraction of even a very small quantity of blood, when the heart is congested, must enable that organ to eject its contents with greater vigour, and consequently to propel them more effectually into the capillary system, which is at that time deprived of its natural quantity of blood.

and in Asiatic cholera.

The use of venesection in the early stage of Asiatic *cholera* admits of a satisfactory explanation on the same principle; and the cause of its hurtful effects in the latter stages of the disease is equally apparent. In the commencement of the disease there is great congestion of the heart, without any apparent change in the constitution of the blood; that congestion may be relieved by venesection; but when the blood has changed its physical qualities, and become viscid from the loss of serum by its enormous secretion into the alimentary canal, then the circulation in the heart, instead of being facilitated after venesection, becomes more languid, and the fatal effects of the disease are accelerated.

When extreme cold produces sleep or torpor, the heart, as well as the other internal viscera, becomes greatly congested, and the vigour of the circulation being consequently diminished, the brain must receive a diminished supply of blood,—hence sleep, and even death, are sometimes caused by cold. The state of torpor from cold is the most perfect sleep that can be imagined, all the functions appearing to cease except circulation, respiration, and absorption.

Effects of cold on the alimentary canal;

Still more pernicious effects on the heart arise from cold applied to the mucous membrane of the *digestive canal.* Drinking cold water, when the body is overheated, I have known to cause very serious disturbances in the heart. In those cases where death has followed from eating *ice*, the fatal effects may be satisfactorily accounted for by the cold producing congestion of the heart.

fatal effects of cold drinks,

(Cases)

A boy, when overheated from play, drank a tumbler of cold water: in half an hour he began to complain of an uneasy feeling in his chest, an embarrassment in his breathing, and a great increase in the impulse of the heart, all which symptoms continued for several days, until he was relieved by venesection.

A young lady had, after supper, danced and partaken of an ice; she suddenly became insensible, and expired in a few minutes.

No less remarkable are the effects of cold upon the heart, when suddenly applied to the mucous membrane of the intestinal canal.

and of a cold enema.

In one well-known instance a nobleman died suddenly after having used an enema of iced water.

Sometimes *Epistaxis* is caused by drinking cold water, the application of cold to the gastro-pulmonary mucous surface causing congestion of the heart, which is relieved by the spontaneous hæmorrhage.

Effects of hot drinks.

Very *hot* substances taken into the stomach have a powerful influence on the action of the heart; hence the common practice of taking warm drinks in order to act on the circulation, particularly upon the cutaneous capillaries.

When food of a very high temperature is taken, which sometimes happens from inadvertence, severe effects on the condition of the heart ensue.

Case

A youth swallowed greedily a small portion of hot potato; he immediately fell down senseless; in this condition he remained about ten minutes. On recovering from the syncope, he felt great pain in the cardiac region, which was succeeded by palpitation, epistaxis, by difficulty of breathing, and cold extremities. In this state he continued nine years, at which period I first saw him. He was then suffering from great disturbance in the circulation.

Case. A *footman*, when carrying a dish of boiled turnips, which were extremely hot, was tempted to eat one, which he swallowed very hurriedly to avoid detection; he expired in a few hours.

Effects of Changes in the Digestive Organs upon the Heart.

Derangement in the functions of the digestive apparatus is another, and also a very frequent, cause of disturbance in the action of the heart.

Food of an improper quality, or food not properly digested, often deranges the action of the heart.

Case. A gentleman, when travelling in a coach, ate a small quantity of baked meat, which was followed by all the usual symptoms of indigestion; besides which there was a great irregularity in the action of the heart, and an intermitting pulse which continued several days.

When there is a febrile state of the system, or even when the body is much debilitated, the presence of a very small portion of animal food in the stomach will sometimes cause great disturbance in the action of the heart; and in those cases of fever where there has been a "relapse" of the febrile symptoms, these have usually been produced by a disturbance in the circulation caused by improper food.

The retention of an unusual quantity of *excrementitious* matter in the large intestines sometimes creates a great disturbance in the heart's action. In other cases this sympathy between the heart and stomach is exemplified by the effect of a purge, which diminishes the vigour of the heart, and creates as much depression as would, in some persons, be produced by a copious blood-letting.

Worms in the intestines have often been known to cause a disordered heart.

Many of the *vegetable* and *mineral* substances which act upon the circulation, and which are first received into the alimentary canal, produce their influence on the heart either after they have been absorbed into and mixed with the blood, or through the medium of the nervous system: their effects may be injurious, or they may be even employed as remedial means, for diseases of the heart.

When endeavouring to trace the causes and the precise nature of diseases in the chest, it is in all cases essential to examine the condition of the digestive organs; as it often happens that their derangement is accompanied by such disturbances in the circulation, as to have led those disturbances to be mistaken for a serious disease of the heart.

Case.

A lady, who died of a cancerous pylorus, suffered so much from a deranged circulation, that, after several careful stethoscopic examinations, three physicians pronounced that the symptoms were caused by an organic affection of the heart.

The effects of vegetable and mineral substances on the heart.

The influence of some vegetable, as well as of some mineral substances, when received into the stomach, on the action of the heart, is very remarkable. It is of great importance to keep this in mind when treating the diseases of this organ, as irregularities in the action of the heart, which have been taken for serious ailments, have been sometimes traced to the accidental exhibition of medicinal substances used for the treatment of some other complaint.

One common cause of a disturbance in the action of the heart is the use of *tea*, particularly *green tea*, which in many persons has a powerful influence on the circulation.

Coffee also produces great nervous excitement from its effect on the action of the heart. I have observed some persons, whose hearts were diseased, suffer much from the use either of tea or of coffee.

Case.

A gentleman of a plethoric habit could at any time, by drinking a cup of coffee, so disturb the action of his heart as to cause hæmorrhage from his nose.

Opium also, when administered in improper doses, frequently disturbs the heart's action, and, by producing restlessness, prevents its anodyne effect on the nervous system. It is the same with tobacco.

Digitalis, which has been called "the opium of the heart," has been much employed to subdue the action of the heart, in those diseases wherein that organ has been preternaturally excited—*belladonna* acts in like manner very powerfully on the heart.

The effects of *hellebore* in disturbing the action of the heart are so remarkable, that soldiers and seamen, wishing to be "discharged," have been frequently known to employ it in order to simulate a disease of that organ.

Tobacco, likewise, has a powerful action on the heart, and its abuse is frequently followed by serious disorders of the circulation.

Case.

" A youth, unaccustomed to the effects of tobacco, smoked a pipe and part of a second, without spitting out the saliva. He became affected by violent syncope, retching and vomiting. Soon afterwards stupor and laborious breathing came on. The countenance was suffused with a deep livid colour; the eyes lost their brilliancy; the conjunctivæ were injected; the right pupil was exceedingly contracted; the left was much larger than usual, and had lost its circular form: both were unaffected by light. The hands were joined, and in a state of rigid contraction; the arms bound over the chest, and the whole body was affected with spasmodic contractions. On the following morning he fainted on getting out of bed. He had much pain in the head and eyes; the eyes and eyelids appeared red and suffused. Pulse natural. Tongue loaded and brownish. Continued to dose. Feet cold. On the third day still dosed, had pain in the head, nausea, and a tendency to fainting. On the evening of this day the patient again became affected with a degree of stupor, spasms of the hands, and stertor in breathing. On the fourth day he was much as on the preceding day, after which he gradually recovered his health."

(*Edin. Med. and Chir. Journal.*)

There are other substances which, when taken into the stomach, mitigate or subdue the heart's action: these form an important class of remedies for the treatment of its diseases.

and of mineral substances.

Of the mineral substances, the preparations of *lead*, of *antimony*, of *zinc*, of *copper*, and of *iron*, have a most powerful influence on the action of the heart. The *acetate of lead*, and the *sulphates of iron* and *zinc*, have been much used to check spontaneous hæmorrhages; and the preparations of *antimony* so powerfully subdue an excited action of the heart, that they are often employed, instead of bloodletting, for subduing inflammatory diseases.

Effects of mercury on the heart.

Observations on the Lues Venerea, by John Pearson.

The use of *mercury* sometimes disorders the heart, that mineral acting as a poison, and "producing depression of strength, a sense of anxiety about the precordia, frequent sighing, trembling, a sense of coldness, sometimes vomiting, and a frequent and quick pulse."

Derangement of the *biliary* secretions is no less frequently the cause of disturbances in the action of the heart. The irregularity in the heart's action, which commonly precedes a paroxysm of *gout*, and which is accompanied by great disorder in the digestive organs, is in all probability caused by their derangement.

The influence of the stomach on the action of the heart, during the digestive process, is very considerable; and any repletion is apt greatly to aggravate all the symptoms of a disordered heart. After a meal, when the stomach is over-distended, the face becomes flushed and heated, and the extremities pale and cold from the unequal distribution of the blood. The relative position of the two organs will explain, how in the horizontal position, especially when lying on the back, the replete stomach will, by its pressure, interrupt the heart's movements.

Flatulency is a condition of the digestive organs which, above all others, causes a disturbance in the circulation, and which, perhaps, more frequently produces a disturbed sleep than even repletion, or the presence of undigested food in the stomach.

Nausea and *vomiting* have a very powerful effect upon the heart's action, being resorted to by the *vis medicatrix*, and are likewise employed as therapeutic agents, to relieve disturbances in the circulation.

The injurious effects of nausea and vomiting in those suffering from a disordered heart, are frequent in persons who suffer from sea-sickness.

Cases.

Dr. M. had been, for many years, subject to increased action of the heart; and after being violently sick at sea, he felt the motion of the ship continue ten days; he also complained of singing in the ears, when he sat down after walking, and when he rose from bed.

A gentleman suffered four weeks with giddiness and feeling as if on board a ship, which came on after having been very sea-sick.

A young lady, who had long suffered from a diseased heart, died suddenly during a voyage in a steam-vessel. There are many persons with disordered hearts, who suffer, more or less, uneasy feelings, especially in the head, when travelling on a railroad.

Effects of Changes in the Vascular System upon the Heart.

The arterial system.

Changes in the functions of the *arteries*, from their dependence on the heart's action, must have a reciprocal influence on the functions of the central organ of the circulation; accordingly, we find that, in diseases of the arterial trunks, or when a trunk is artificially obliterated, more or less disturbance takes place in the action of the heart. In aneurismal arteries, the heart's movements are often greatly deranged, particularly towards the latter stages of that disease.

Influence of the capillary system,

The consent between the *capillaries* and the heart, especially those of the cutaneous and gastro-pulmonary mucous surface, renders the heart greatly affected in disorders of that system of vessels. Such disturbances of the heart are exemplified in all inflammatory affections, wherein the action of the capillaries is deranged, and which are marked by a chill or rigour, by paleness of the integuments, by heat, flushing, and profuse perspirations.

A diminution in the quantity of blood in the capillary system produced from cold, it has been already noticed, causes a corresponding congestion in the heart.

and venous system.

Many diseases of the *veins* have also more or less influence on the circulation, especially on that of the right heart.

It is a curious pathological fact, that inflammation of a vein, caused by a wound, generally extends along the internal coat of the wounded vessel towards the heart; but in *horses*, where the opening in venesection is usually made into the external jugular vein, if *phlebitis* supervenes, which is not a very unusual occurrence, the inflammation of the internal tunic of the vein does not extend along the trunk of the vein towards the heart, but along its ramifications to the head.

Effects of Changes in the Genito-Urinary System upon the Heart.

Influence of the uterine system on the heart.

Another, and by no means an unusual, cause of a disorder of the heart, is a morbid condition of the *uterus ;* the heart sympathizing in a remarkable degree with the uterine system.

In health, the uterine functions are so intimately connected with the organs of circulation, that we naturally expect to find that disorders of the uterus will have a powerful influence on the action of the heart; and hence in painful menstruation, at the period of the cessation of the menstrual flux, and especially during gestation, the functions of the heart are often greatly disturbed.

We likewise find that many affections of the uterus are relieved by those medicines, such as the preparations of iron, zinc, and copper, which act directly on the organs of circulation. The sickness and vomiting which so frequently accompany pregnancy, seem to depend on a disturbance of the heart; therefore we can explain how relief is obtained by the abstraction of a small quantity of blood when employed under such circumstances.[1]

The *urinary organs* are often sympathetically affected in disturbances of the circulation. Nothing has been considered more characteristic of the *nervous temperament*, than a copious secretion of pale urine; it is a striking feature in *hysteria*, in which ailment the organs of circulation are more especially affected.

When, besides the disorder of the heart, there is derangement in the digestive organs, particularly in the liver, the urine is in small quantity, and becomes high-coloured, depositing a more or less copious sediment. The absence of such changes in the urine affords a proof that the disordered circulation is not caused by any disturbance of the digestive apparatus.

Effects of Hereditary Diseases upon the Heart.

Hereditary causes.

Besides those disorders which are caused by changes in the qualities of the blood, there is a *hereditary* predisposition in the heart, as in all other organs, to particular diseases. Of diseases of the heart of a hereditary character, there are many instances recorded by the earlier writers; and abundant examples of such diseases have fallen under my own observation. It may, indeed, be offered as a general remark, that there is no race of mankind, no family, in where there is not some imperfection in their organization, as well as a predisposition to some particular ailments, or to diseases of some particular organs. Thus, many branches of some families are frequently affected with diseases of the brain, such as apoplexy or hydrocephalus; other families with diseases of the lungs, such as pulmonary phthisis; and others are particularly subject to diseases of the liver.

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[1] "Les parties de la génération dans l'un et l'autre sexe ont une action bien marquée sur le cœur. Combien de fois l'usage trop fréquent des plaisirs de l'un sur l'autre n'a-t il pas occasioné ou des syncopes ou des palpitations. N'est il pas aussi affecté dans les femmes qui éprouvent des affections hystériques par maladie de l'utérus ou des autres parties de la génération ?"—Portal., tom. iii, p. 73.

"The colour of the skin and hair," observes Corvisart, "the features, the expressions of the countenance, the voice, the general proportions of the body and stature, the peculiarities of form, the gesture, habits, disposition, and taste, peculiarities in the sight and hearing, the temperament—in short, all the physical and moral qualities descend more or less from parents to their children."

These remarks strictly apply to the heart, that organ being often diseased in numerous branches of the same race. There can be no more striking proof of the hereditary nature of some maladies of the heart, than the well-known fact that, in our Royal family, George II., George IV., William IV., and the Duke of York, all died of diseases of this organ.

CHAPTER XV.

SYMPTOMS OF THE DISEASES OF THE HEART IN GENERAL.

The physiological and the anatomical symptoms; the important addition of the physiological symptoms to semeiology; the physiological symptoms disregarded by Laennec; unfavourable influence of this opinion; table of the physiological symptoms.

The symptoms which accompany diseases of the heart arise, not only from changes recognisable in the heart itself, but, likewise, as will be shown, from disturbances in the functions of those organs and systems of organs, with which the heart is associated, and with which it co-operates in executing the great functions of life. Whenever, from any cause, the action of the heart is changed, and the blood is no longer duly distributed throughout the body, the disturbances which the irregular or altered circulation produces in the various organs are *symptoms* of disordered heart. Nothing, indeed, is more remarkable, when we contemplate the pathological condition of the human frame, than to observe the assemblages of symptoms in its numerous maladies, which are caused by differences in the supply of blood to particular organs.

The two classes of symptoms—the physiological and anatomical.

The symptoms of disorders of the heart, like those of other organs, may with propriety be divided into two separate classes, the general or *physiological*, and the local or *anatomical*. The first class of symptoms consists of those which are caused by disturbances in the different systems of the economy—in the cerebro-spinal, in the respiratory, digestive, genito-urinary, vascular, and muscular systems; whilst the second class of symptoms comprehends those changes which take place in the impulse, sounds, sensibility to the touch, form, and in the position of the heart.

The physiological symptoms considered

Let us commence our inquiries on this subject by considering the *physiological* symptoms. I am induced to adopt this arrangement for several reasons, more especially because the functional diseases of the heart form a most important part of this work, and these disorders, as will be shown, are chiefly characterized by the physiological symptoms; whereas the local or *anatomical* symptoms are more characteristic of changes in the structure of the heart's tissues, or of its organic diseases.

Their addition to symptomatology.

To me, indeed, it appears that the symptoms which may be derived from a knowledge of the influence of disturbances of the heart on the different systems of the economy, are far more essential, in order to establish a correct *diagnosis* of these diseases, than the anatomical symptoms. At all events, the physiological symptoms, it must be admitted, form an important addition to *semeiology;* and it must also be admitted, that all those symptoms, the presence of which is made known by the patient himself, deserve to be far more relied upon, for their accuracy, than those which are recognisable only by the senses of an observer. Our senses, indeed, are very prone to error, of which we daily meet with abundant proofs in the discrepancy of the opinions formed by different eminent men, even in cases of external diseases, where every opportunity is afforded of rigidly examining them by the senses both of sight and of touch.

The senses prone to error.

The physiological symptoms neglected by Laennec.

I am now, undoubtedly, taking a very different view of the importance of the physiological symptoms, from that which has hitherto been generally entertained, especially by Laennec, whose researches on the diseases of the heart have been so highly appreciated, but who appears to me to have erred, when attempting to give an undue importance to the physical signs of these diseases, and to have altogether disregarded, and endeavoured to undervalue, the importance and utility of the physiological symptoms.

"The true signs of organic affections of the heart are derived from percussion, but *above all* by auscultation; and besides these signs, which are purely physical, *some physiological symptoms, caused by disturbed functions, and, taken by themselves, extremely vague*, can sometimes acquire a degree of certainty which they had not before possessed."

Laennec, tom. ii., p. 382.

This opinion of Laennec is the more to be regretted, as it has had the effect, not only of impressing upon the minds of other inquirers, that the *physiological symptoms* are of little value, but

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his views seem to have created an insurmountable barrier to all future investigations upon this subject. Nay, further, from such an unfavourable impression having been made by so great an authority, his followers have paid their almost undivided attention to the physical signs of the diseases of the heart; so that the evils which have arisen from this neglect of the physiological symptoms have been very injurious. Assuredly, all who have been engaged in the practical duties of their profession, must have become acquainted with numerous instances of the most serious errors, and of the most discrepant opinions given by those who have confided in *auscultation*, in forming a diagnosis of the diseases of the heart. The physical signs, in revealing organic diseases of this organ, are undoubtedly of value; but when we endeavour to discriminate the various functional disorders of the heart, auscultation is, comparatively, of little import; whilst we shall find that the *physiological* symptoms afford far more certain guides, and enable us to follow a more decisive system of treatment.

TABLE OF THE PHYSIOLOGICAL SYMPTOMS.

SYMPTOMS DERIVED FROM THE	Cerebro-Spinal System, .	Brain. Spinal Cord. Ganglionic Nerves.
	Respiratory System, . .	Aspirations. Voice.
	Digestive System, . . .	Stomach. Intestinal Canal. Biliary Organs.
	Vascular System, . . .	Arteries. Capillaries. Veins.
	Muscular System, . . .	Voluntary Muscles. Involuntary Muscles.
	Genito Urinary System, .	Generative Organs. Urinary Organs.

CHAPTER XVI.

SYMPTOMS OF DISEASES OF THE HEART DERIVED FROM THE CEREBRO-SPINAL SYSTEM.

The symptoms in diseases of the heart derived from the cerebro-spinal system; erroneous opinions of nervous diseases; table of symptoms; symptoms arising from changes in the proportions of the arterial and venous blood, and from morbid changes in different portions of the brain; symptoms derived from changes in the spinal cord; symptoms derived from the ganglionic system; the particular symptoms considered, headache, giddiness, mental irritability; watchfulness, dreaming, somnambulism, syncope; coma, catalepsy.

Symptoms derived from the cerebro-spinal system.

Whenever the action of the heart is disturbed, no system of organs is more quickly influenced, by even the slightest change in the circulation, than the *brain* and *spinal cord;* and therefore, the affections of the cerebro-spinal system afford a most important class of *symptoms* in the diseases of the heart.

Erroneous opinions of nervous diseases.

Having shown that the brain and spinal cord have not only a larger quantity of blood, more security against the supply being interrupted, more means provided in order to prevent irregularities in their circulation, than any other organs, we are prepared to find, that certain symptoms must arise in the nervous system when the action of the heart is disturbed. These symptoms merit the more consideration here, not only as they have not been deemed of sufficient importance by those distinguished authors who have professed to treat of the diseases of the heart, but as most of them have been arranged by nosologists, as *primary* affections of the nervous system; whereas it will appear that many of the diseases to which the name *nervous* is usually applied are, in fact, merely *symptoms* of a disordered circulation. This subject opens an extensive field of pathological research; and if the physiological views which I have endeavoured to establish in the preceding part of this work be correct, and if the pathological doctrines, now about to be expounded, can be clearly established, they will not only show the propriety of adopting essential nosological changes, and of refuting opinions which have long been very generally entertained; but these views will also assist in explaining the *modus operandi* of some of those remedies which experience has long found to afford relief in affections of the nervous system.

Parry's Elements of Pathology.

Whilst making these remarks, I ought not to omit alluding, in a particular manner, to the valuable works of Parry; and, though he did not consider that morbid states of the cerebro-spinal system arose from *primary* disorders of the heart itself, nor treat them as symptomatic affections of the central organ of the circulation, yet he considered that these nervous affections depended upon "an increased momentum of blood to the brain," and that "a large proportion of nervous affections originate in a disordered state of circulation with regard to the brain."

Influence of the blood on the nervous system.

Physiologists, I have already had occasion to remark, do not seem to have fully appreciated, nor to have duly considered the powerful influence of the *blood,* and the effects which the various changes in its distribution have upon the cerebro-spinal system; for whatever be the consent between the brain and the heart through the medium of nervous filaments, in a still greater degree does that consent depend upon the blood.

We have also seen that the various organs have not only different quantities of blood allotted to them, but that their circulation is variously modified under different circumstances, and that they all perform their functions more or less perfectly, according as they receive their proper supply of the vital element.

Diseases caused by changes in its distribution.

This influence of the blood appears no less remarkable, when we contemplate the diseases of the different systems of the economy; a vast number of morbid phenomena being distinctly caused by changes in the distribution, as well as in the qualities of the blood.

That the circulation in the *cerebro-spinal* system is of equal importance for the due performance of its functions, and that inequalities in the supply of its blood is a cause of diseases in that system, in the same manner as similar changes in the circulation produce them in the other systems, we are entitled to conclude, especially from the more than ordinary means that are employed by the economy to prevent the requisite supply of the vital element to the nervous system from being interrupted by any of those accidental causes which, more or less, alter the circulation in other parts of the economy.

The protection which the vertebral arteries receive by passing to the brain through bony canals; the spinal arteries being derived from the vertebrals; the free anastomoses of the cerebral arteries; the remarkable peculiarities in the arrangement and distribution of the venous system, and the large proportion of blood with which the brain and spinal cord are supplied, surely ought, when viewed collectively, to point out the great necessity for that system having a regular supply of blood. Therefore, in proportion as the regularity in the supply of blood is of importance for the execution of the healthy functions of the nervous system, it may be inferred that any derangement in that circulation will be proportionably more injurious, than irregularities in the circulation of those organs to which so uniform a supply and uninterrupted circulation of the blood is not required.

Such, then, being the influence of the blood upon the nervous system, it is not surprising that changes in the circulation should cause a proportionate number of changes in the functions of that system; and it is remarkable that those who have endeavoured to investigate the diseases of the brain and spinal cord, should not have taken into consideration the powerful influence of the blood, and traced some of the maladies of the nervous system to changes in the functions of the heart.

That the nervous system is subject to various disorders from changes in the quantity of its blood, or from changes in the proportion of the two bloods, is a pathological fact which has long been universally admitted. But whilst it has been established, by the most incontrovertible evidence, that there are changes in the circulation within the head caused by disorders of the heart, it is remarkable that, until the observations of Portal, Parry, Corvisart, Laennec, and others, none of those disturbances of the cerebral circulation had ever been attributed to a primary change in the action of the heart, but to diseases in the blood-vessels of the brain itself: whereas it would have seemed very natural for pathological inquirers to have considered, how far such disturbances in the cerebral circulation might depend upon changes in the functions of the central organ of the circulation itself. So improbable has it appeared to some, that the brain should in any way be more influenced than other organs by changes in the functions of the heart, that even one of the latest and most able writers on the subject has observed that "the blood being impelled in every direction by an impulse primarily derived from the heart, it is not easy to conceive how, in the natural state of the parts, it should be propelled to the head with greater force, or in greater relative quantity than to any other part of the body." Abercrombie. This error is to be altogether attributed to no cognizance having been ever taken of that peculiar arrangement of the cerebral arteries, which I have fully explained, and by which it appears that very unusual means are employed in order to provide at all times the *cerebro-spinal* system with the proper quantity of arterial blood, and to supply every part of that system equally; whilst the remarkable peculiarities in the structure and arrangement of the veins is calculated to guard against cerebral congestion.

Except in those cases where there is a local disorganization within the head, it is not easy to conceive how any change in the cerebral circulation could take place unless it were caused by a disturbed heart; and I cannot hesitate to affirm that in those cases of apoplexy, convulsions, hysteria, and such-like diseases, when they have arisen from moral causes, of which the records of medical science afford so many instances, they have been all produced by a disordered heart.

Other causes of nervous disorders;

From what has been now said, it must not, however, be supposed that any attempt is here being made to deny that various affections, to which the term "nervous" has been applied by medical writers, may not originate in other causes besides a disordered heart. On the contrary, in many instances, nervous symptoms can be distinctly traced to a morbid change of structure in some portion of the cerebro-spinal system, or in some of those tissues by which that system is enveloped; and likewise, in other instances, the nervous affection may be *sympathetic* of a derangement of the digestive or genito-urinary apparatus.

Their diagnosis important.

In pursuing our investigations into this branch of semeiology it is, therefore, essential to keep in view the different *causes* which may influence the functions of the *nervous* system; and, in every example of nervous disease, endeavour, by a rigorous examination of the particular condition of each of the different systems of the economy, to discriminate in what organ, or in what system of organs, the primary affection exists.

Causes of the different symptoms.

The symptoms which arise in the cerebro-spinal system from a disturbed circulation present considerable variety,—some are caused by an increase in the proportion of the arterial blood; some by an increase in the proportion of the venous blood; some by a diminution in the velocity of the current in the arterial blood, or in the vigour of the circulation; some by changes in the chemical qualities of the blood; and some by the admixture of the venous and arterial bloods.

Further, it may be observed that a particular assemblage of symptoms takes place either when the whole cerebro-spinal system is simultaneously affected;—when one or other of the great nervous centres,—or when only a portion of one of these is affected.

The proportion of the arterial blood increased.

Of the *first* class of these numerous symptoms, or those which are caused by an increase in the proportion of the *arterial* blood in the cerebro-spinal system, we have examples in febrile diseases, where headache, irritability of mind, restlessness, and involuntary action of the muscles are almost constantly present; as also in some cases of apoplexy and paralysis.

The proportion of the venous blood increased.

Of the *second* class, in which there is that assemblage of symptoms arising from an increase in the proportion of the *venous* blood, we have examples in lethargy, stupor, and coma.

The velocity of the blood's currents diminished.

In the *third* class of symptoms, where there is a diminution in the velocity of the current of the blood, the condition of the brain is characterized by a difficulty in balancing the body, reeling, vertigo, or a sensation of "swimming in the head," diminution of muscular power, and syncope; all which symptoms are exemplified in those cases of depletion where there has been a great loss of blood, or in those who have suffered from severe purging.

The admixture of the two bloods.

Of the *fourth* class of symptoms—those which are caused by a change in the *qualities* of the blood, we find examples in chlorosis, jaundice, and in those congenital malformations and changes of structure where, from a communication between the pulmonic and systemic hearts, there is an admixture of the two bloods.

The different arteries disturbed.

In the *fifth* class of symptoms, the circulation is disturbed by the current of blood being changed either in the internal carotids or in the vertebral arteries. From the differences in the course and arrangement of these vessels we may legitimately conclude that the changes in the brain, and the symptoms arising from a disordered arterial circulation, will necessarily differ, according as these changes are caused by a disturbance in one or other of these great arterial trunks.

The different portions of the cerebral system affected.

In the *sixth* class of symptoms, where only a portion of the cerebral system is affected, those parts of the brain which execute the intellectual functions are influenced singly or in combination, when the action of the heart is even temporarily disturbed; hence arise irritability, passion, even mental aberration, and the various shades of intellectual energy.

The same observation applies to other portions, or to other organs of the brain; each of them being affected separately in different disorders of the circulation.

The cerebral nerves affected.

Particular nerves, also, have their functions disturbed in certain disorders of the heart, especially those of hearing and of sight; and hence arise unnatural sounds, ringing in the ears, and the various forms of ocular spectra.

At first it may seem strange that each of the different portions of the nervous system should be thus affected separately in diseases of the heart, the whole of that system being supplied with blood from the same channels; but, remarkable as that may appear, we yet find many analogous phenomena in diseases of other parts of the body, as well as in the effects of many medicinal substances.

We see, for example, that branches come off from the aorta to supply the liver, the stomach, and the kidneys; and, when these arteries enter their respective organs, their distribution is then modified in each, so that the circulation is carried on in such a manner as to enable them to execute their particular functions.

Doubtless, it must be the same as regards the vascular distribution in the different portions of the nervous system. The functions of each of these portions are quite different, each requires a different vascular distribution, and, consequently, each portion may be diseased separately.

As regards the influence of medicinal substances on the nervous system, there is none with which we are more familiar than the effect of particular substances on particular portions of that system through the medium of the blood: such as the influence of *belladonna* on the iris; of *strychnine* on the motor, of *chloroform* on the sensory column of the spinal cord, and of the *ergot of rye* on the uterus.

As many affections of the brain have never been traced to a primary disease of the heart, so disorders of the spinal cord have been seldom attributed to a disturbed circulation. But that the *spinal cord* should be affected in a similar manner as the brain is by changes in the circulation, and thus afford an equally important class of symptoms in diseases of the heart, may be anticipated from the interesting and no less important anatomical fact to which I have formerly alluded,—that the whole cerebro-spinal system is supplied with blood from the same channels; and, therefore, that whatever causes any alteration in the circulation of the brain, must have a like influence on the circulation of the blood in the spinal cord. If the opinion of Gallois be correct, that the heart derives its chief motion from the spinal nerves, we are naturally led to expect that, when the heart is disordered, a wider range of morbid changes will be produced in the functions of the spinal cord than even in those of the brain itself. Comparative anatomy, which contributes so much to illustrate physiological inquiries, seems to strengthen this opinion, Clift having found that "the muscles of the body of a *carp* can be thrown into powerful action four hours after the brain and heart have been destroyed; but the moment the spinal marrow was destroyed, the muscles lost all power of action."

Symptoms derived from the spinal cord.

Relation of the spinal cord and heart

illustrated by comparative anatomy.

Phil. Trans., 1815.

The spinal cord, besides being liable to be influenced by all those changes in the circulation which disturb the functions of the brain, has also, like the brain, only particular *portions* affected in different diseases of the heart; and all the changes in the spinal cord afford also, we shall find, an important addition to the catalogue of *symptoms* in the heart's diseases.

Five classes of symptoms derived from the spinal cord.

The first class.

The *first* class of these symptoms arises from the *motor* column being affected, causing involuntary actions of the muscles which it supplies, or producing a diminished power of these muscles; and in either of these cases only one, or a larger number of the motor nerves, may be affected.

The second class.

A *second* class of symptoms is caused by a change in the *sensory* column, in which there may be either an increase or a diminution of sensation, and either the whole, or only one nerve of that column, may be affected.

The third class.

In a *third* class, the symptoms arise from either one or more nervous trunks both of the motor and sensory columns being affected at the same time.

The fourth class.

In a *fourth* class, the symptoms arise from either the motor column of one side only, or the sensory column of the other side of the body being affected.

The fifth class.

And in a *fifth* class not only are both columns of the cord, but, likewise, the cerebral functions deranged; these changes taking place, in some instances, to such a degree, that nothing appears to exist but organic life.

Of all the different symptoms derived from the spinal cord, and of their various combinations, we have abundant examples in those cases of apoplexy, palsy, convulsions, hysteria, epilepsy, catalepsy, chorea, tetanus, and syncope, wherein the primary disease is seated in the heart.

Sir Charles Bell's discoveries.

These pathological phenomena, to which I have just alluded, afford a beautiful illustration of the important discoveries of Bell. The investigations of that eminent physiologist, taken conjointly with the views which I have given of the circulation in the cerebro-spinal system, will, I am persuaded, essentially contribute to explain many pathological conditions of that system of the economy. Nor does it appear to me by any means unreasonable to anticipate that we may be ultimately able to refer affections of the roots of the different nerves, and of particular portions of the brain, each to some corresponding morbid condition of the heart; and, further, that we shall be able to explain how one person with a disordered heart should complain of ringing in the ear; another of false images before his eye; another of vertigo; another of convulsions; another of neuralgic pains, and another of the loss of sensation.

Symptoms derived from the ganglionic system.

As the heart is supplied with nerves, chiefly from the *ganglionic* system, it may be anticipated that, in the diseases of the heart, the different organs which are supplied by that nervous system will be more or less influenced.

Hence arise the sympathetic affections of the stomach and other abdominal viscera, and likewise those disturbances in the organs of respiration which frequently accompany diseases of the heart—all which affections will be found to afford important symptoms in the semeiology of this organ.

The particular symptoms considered.

Thus far I have endeavoured to give a general view of the various *symptoms* which are manifested in the nervous system when the functions of the heart are disturbed. In prosecuting further investigations, we are now led to examine more in detail some of the most prominent of these symptoms; in order to facilitate this inquiry, a table of them is annexed; and, to preserve some order, those are first mentioned which appear to influence the whole nervous system; then such as chiefly affect the brain and the nerves emanating from it, and afterwards those which are more especially derived from the spinal cord. I am at the same time aware that such an arrangement is merely arbitrary, for, as in all our inquiries on this subject, it is requisite ever to keep in mind the unity of the whole cerebro-spinal system in its diseased as well as in its healthy state.

Table of the Symptoms derived from the Cerebro-Spinal System.

Headache.
Giddiness—*Vertigo.*
Mental Irritability and Aberration.
Watchfulness—*Insomnia*
Dreaming.
Somnambulism.
Somnolency.
Syncope.

Coma—*Lethargy.*
Catalepsy.
Apoplexy.
Epilepsy.
Hysteria.
Convulsions.
Palsy { *Hemiplegia.*
Palsy { *Paraplegia.*

Chorea.
Tetanus.
Tremors.
Shaking Palsy.
Neuralgia.
Angina Pectoris.
Ringing in the Ears.
Ocular Spectra.

Headache.

Pain, uneasiness, weight, tightness, throbbing, swimming, giddiness, are all sensations in the head which are experienced by those who are suffering from a disordered heart. These different feelings are found to be present in two very opposite conditions of the brain—the one arising from an increase, and the other from a decrease, in the vigour of the circulation.

Headache from increase of arterial blood;

There are no pains in the head more frequent than those which are the effect of that increased action of the central organ of the circulation which takes place during febrile diseases, and also those which arise from violent mental emotions. "In many fevers the symptoms are kindled up in the brain, which points out an increased action of the heart. There is not only headache, but all the perceptive powers become preternaturally acute. The patient hears the sound of the approaching carriage, or of the distant nightingale, while to those who surround him everything is clothed in darkness and silence; ideas pass through the mind with such velocity, that the apparent period of a month is comprised within the limits of a day, and the patient is conscious of a corresponding rapidity of utterance which he feels himself with difficulty able to control." (Parry)

Headache, too, often accompanies those temporary increased actions of the heart which are produced by overheated rooms and crowded apartments, the headache in such cases being caused by an increased quantity of the systemic blood sent to the head.

The headache which comes on when a person has been suddenly awoke out of a profound sleep, marks also a change in the circulation. The action of the heart is then increased; the consequence of such inordinate action is, that an additional quantity of arterial blood passes into the brain. The uneasiness in the head in such cases usually continues, until the general circulation is tranquillized by a renewal of sleep, or by an additional quantity of arterial blood being directed to the stomach by the presence of some food, by which the quantity of arterial blood in the brain suffers a corresponding diminution.

If a person be suddenly awaked, surrounded by unpleasant objects, he is apt not only to have headache, but his mind to be irritable;—so much does the day depend upon the sensations which we experience on waking, that Montaigne would never allow his child to be awoke but by the sound of music.

from a diminution of arterial blood.

No less severe is that headache which follows large depletions, and which, being caused by a diminished supply of arterial blood in the brain, is relieved by those means that are known to increase the vigour of the heart's action, such as *ammonia*, *camphor*, and *wine*.

The headaches, whether caused by an increase or by a diminution of the arterial blood in the head, are of a very different character from those uneasy feelings caused by an increase in the proportion of *venous* blood, and which are characterized by more or less lethargy and stupor.

Giddiness.

Vertigo.

There is a particular class of sensations in the head, which are different from those already mentioned, that are of frequent occurrence, and are also important *symptoms* in disorders of the heart. The sensations to which I allude are dizziness, reeling, or "swimming in the head," or a want of power to balance the body, sensations which come on suddenly, continue only for a short time, and often create much alarm—all which are caused by a *diminished* supply of arterial blood to the brain.

Such feelings are very different from those caused by an increased quantity of arterial blood, or by a congestion of venous blood; and they are very different from the uneasy feelings or pains in the head which are symptomatic of a derangement in the digestive organs, although these various conditions are apt to be confounded with each other.

Difficulty in balancing the body.

There is no symptom which may be considered more pathognomonic of a disturbed heart than a difficulty in balancing the body when attempting to walk, or to change suddenly from the horizontal to the erect posture. Hence many of those afflicted with a disorder of the heart occasionally find it necessary to catch hold of some fixed point in order to prevent themselves from stumbling. "We totter when we get up, and if we lay hold of anything the hand lacks its wonted strength." Macnish.

Mental Irritability and Aberration.

There is no more frequent *symptom* of a disordered heart than mental *irritability;* though, in some instances, it may be difficult to trace whether the irritable state of the mind is caused by a disturbed heart, or the disturbance of the heart be the effect of an irritable mind. I am disposed to believe that, in the great majority of such cases, the state of the intellectual faculties depends entirely upon the condition of the heart; and, therefore, that the disordered state of the nervous system may be taken as an index or sign of some change in the function of the central organ of the circulation; especially in those cases where the disturbed state of the nervous system is accompanied by other well-established diagnostic symptoms of a disordered heart.

The nervous temperament explained.

The *nervous temperament*, commonly so called, appears to depend either on an unusually excitable nervous system, or upon an irritable or easily excited heart; for the same class of symptoms will arise, whether the brain excite the heart, or the heart excite the brain; and both these conditions may be combined in the same individual.

An irritable state of mind, like headache, may be caused either by an increase, or by a diminution in the proportion of the arterial and venous blood within the head. When the action of the heart is increased by violent passions, there is a corresponding increase in the flow of arterial blood to the head; the mind becomes more or less irritable, impatient, and unequal to its usual avocations. On the other hand, an irritable condition of the mind, arising from a diminution of arterial blood within the head, often follows depletion or exhaustion—a state which is relieved by sleep, food, or cardiacs properly so called.[1]

There is a very peculiar state of mind in those suffering from disorders of the heart, and which, as far as my own observation goes, may be considered pathognomonic of an affection of this organ. In the condition of the mind to which I allude, the sufferer has a fearful *apprehension of evil*, being harassed with the most painful and distressing emotions, giving to the countenance that peculiar expression, the *facies propria*, so frequently to be remarked in those afflicted with a diseased heart.

This disquietude of mind is very different from mental irritability, or common "depression of spirits;" all those who are afflicted with it, whatever be their natural disposition and moral and physical courage, describe their sufferings to be a sense of impending death, with a most alarming apprehension of that event. This state of mind varies in degree; but, as a general remark, I may observe, that all those, whose circulation is disturbed, suffer more or less from what are usually called *nervous* symptoms; the term *nervous* being used figuratively, and applied to their moral condition.

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[1] "*Mental Excitement.*—The beasts show us plainly how much our diseases are owing to the perturbations of our minds. We are told that the inhabitants of Brazil die of old age, owing to the serenity and tranquillity of their souls, which are free from all passion, thought, or laborious and unpleasant employment; as great enmities spring from great friendships, and mortal distempers from vigorous health, so do the most surprising and the wildest phrensies from the high and lively agitations of our souls."—*Montaigne.*

Case.

An *officer*, distinguished in the field of battle, suffered from a congestion of the heart, which had been caused by a domestic affliction. When, from any temporary excitement, the circulation was suddenly disturbed, he was attacked with sensations of fulness, and what he called "spasms in the chest;" these were accompanied by a painful apprehension of death; but at other times, when free from these spasms, he felt his courage unsubdued.

Thompson.

Case.

A *nurse*, who had a disordered heart from long watching, and whose sleep had often been interrupted, complained of a sensation of fulness, and of uneasy feelings in the chest, and frequently apprehended sudden death. "I cannot understand," she said, "how it should be that on these occasions I have such a terror of dying, for my general state of mind, when in health, is, instead of fearing, quite the contrary."

This state of mind forms a striking contrast to that of persons, who, in the last stages of pulmonary *phthisis*, so frequently look with perfect confidence to their recovery; also to that of those who suffer a depression of spirits caused by *dyspepsia* and disorders of the digestive apparatus, by whom death is often looked forward to even with hope; and likewise to that of those who have affections of the head of an inflammatory character, and in whom there is usually a state of mind which disposes them either to injure themselves or those around them.

Insanity.

The influence of the heart upon the brain opens an interesting field of research to those who are employed in the investigation of the diseases of the mind; as I am convinced that, in many cases of *insanity*, the primary cause of the condition of the brain will be found seated in the heart; especially in those examples of mental aberration where the heart has been

CHAP. XVI. "broken" from mental affliction, with examples of which history abounds.

Such cases of lunacy will be found to have, indeed, a very different character from those which are caused by a morbid condition of the brain or its membranes: it is scarcely necessary to remark, that the system of treatment calculated to remedy the one class of cases is not applicable to the other. In most instances of insanity arising from disturbances of the heart, where the success of certain remedies employed in the treatment of the insane chiefly depends—such as the various modes of gestation, swinging, and rotatory movements, nausea and vomiting, all these must relieve the sensorium by the effects which they have in diminishing the vigour of the circulation. So likewise with regard to the use of tartarized antimony and of hellebore, both of which act upon the heart. Hellebore, which I have already mentioned, has been employed to simulate disease of the heart, was, by the ancients, considered almost a specific for the cure of insanity. See p. 161.

Watchfulness.

Insomnolence.

Having pointed out how sleep and wakefulness depend upon the alternate diminution and increase of the vigour of the circulation, we naturally anticipate that these two conditions of the system will vary according to the state of the central organ; hence irregularities in sleep and waking may be considered as *symptoms* in disorders of the heart.

In disturbances of the heart we find that sleep is changed either in its duration, or it is imperfect.

Insomnolence, or *watchfulness*, is one of the most usual deviations from natural sleep, and it is one of the most distressing symptoms which often accompanies a disordered heart.

As the quantity of sleep, like that of food, necessary to preserve health, is very different in different individuals, it is difficult to point out when watchfulness becomes a symptom of disease. Sleep, indeed, not only varies in duration in different persons, but even in the same person at different times; we never sleep twice precisely in the same manner. Most people sleep only once a day, and their sleep is generally about eight hours; so that man spends nearly one-third of his life in sleep!

We are told that Reid, the profound philosopher, could partake of as much food, and immediately afterwards of as much sleep, as lasted him for two days.

John Hunter only slept five hours a day. A student, who brought a letter of introduction to Hunter, was not a little surprised when Hunter invited him to breakfast the next morning at five o'clock.

It is marvellous to what extent the maniac will remain in a waking state without any apparent injury.

Case.

A man never slept, and yet he enjoyed good health, living till his seventy-third year. He had a kind of *dozing* for about a quarter of an hour once a day, which was all the rest he was ever known to take.

Medico-Chirurgical Transactions.

Men generally are best refreshed with one slumber,—a second sleep often causing restlessness or headache. Aristotle, when he reclined to sleep, kept one of his arms hanging out of the couch, with a ball in his hand, which, the moment his sleep became profound, dropped into a brazen basin placed on the floor; by the noise he was instantly awoke. Wellington slept in a bed so narrow, that he could not turn himself without waking. "Whenever a man turned himself in bed," he used to say, "it was time he should rise."

Some people have the power of falling asleep at will; by thus dividing sleep, the mind can be occupied for a greater number of hours in each day.

Of Napoleon, his biographer informs us, "Nature had bestowed upon him a constitution so admirably suited to his station, that a single hour of sleep would restore him after twenty-four hours' fatigue. In the midst of the most serious and urgent events, he had, at pleasure, the power of resigning himself to sleep."

Bourrienne.

It is by the exercise of this power that the most beneficial results are derived by those who are exposed to much mental exertion. The mind, like the body, has not only its alternate seasons of activity and repose, but, by that faculty which I have now mentioned, when one of the cerebral functions has been fatigued, and the mind occupied in some other pursuit, the cerebral organ which had been exhausted then becomes refreshed, and again able, if called upon, to perform vigorously its functions.

Every one is familiar with the effect of great mental excitement, immediately before the usual hour of rest, in causing watchfulness; such excitement producing an inordinate action of the heart, and the increased action of the heart increasing the quantity of arterial blood within the brain.

Those afflicted with a disturbance of the heart suffer various imperfections of sleep. When in a profound sleep, they sometimes start up in bed completely awake, and are obliged to remain in an erect position, in order to relieve a sense of impending dissolution. They are also subject to frightful dreams; sometimes their sleep is of too long duration, and they are awaked with difficulty.

In many febrile diseases, when the action of the heart is much changed, "sleep becomes almost wholly wanting, or is very imperfect. The patient for a while forgets the surrounding objects; horrid images present themselves to his sight, so exactly mocking realities, that he starts out of his sleep violently agitated, and for a while hardly believes that he was in a dream."

Parry.

After describing the sleep of health, an elegant writer reverses the picture, and paints with his finished pencil the sleep of disease. "It is short, feverish, and unrefreshing, disturbed by frightful or melancholy dreams. The pulse is agitated, and there are frequent startings and twitchings of the muscles. Nightmare pressing like an incarnation of misery upon the frame; imagination, distempered by its connexion with physical disorder, ranging along the gloomy confines of terror, holding communication with hell and the grave, and throwing a discolouring shade over human life."

Macnish.

Dreaming.

As it has been pointed out, that during perfect sleep there is a suspension of all the cerebral functions, so we find that there are various imperfections of sleep, each of which is caused by one or more of the cerebral organs being kept awake. It is the waking state of one of the cerebral organs, or of isolated portions of the brain, which causes dreaming; and, therefore, the various kinds of dreaming may be considered *symptoms* of a disordered circulation.

An analogy may be remarked between dreaming and delirium; "dreaming being considered as only a transient paroxysm of delirium; and delirium as a permanent dreaming;" or, as Abercromby has said, "the difference of the two states of the brain is, that the erroneous impression in delirium is permanent, and affects the conduct; whereas, in dreaming, the vision disappears on waking, and has no influence on the conduct." Rush. Abercromby.

There appears, also, to be an analogy between *sleep* and *wakefulness;* for all the cerebral organs are not equally active when we are awake, and some functions are altogether suspended. "We have even a power within ourselves to be insensible to impressions on certain organs under particular circumstances," Bichat. as is often exemplified in those of hearing and sight: loud sounds, or sounds we are accustomed to hear, or the most interesting objects passing by unobserved, when other organs are in a state of great excitement.

> "That sleep's the loveliest,
> Since it dreams the least." Byron.

Somnambulism.

Of all the imperfections of sleep, caused by a disordered heart, none is more remarkable than somnambulism; a condition of the cerebro-spinal system in which some only of the organs of that system are awake.

> "Strange state of being:
> Senseless, to feel; and with seal'd eyes, to see!" Byron.

The changes in the condition of the spinal cord during disturbed sleep, are similar to those which take place in the brain; for whilst the functions of all the spinal nerves, except those of organic life, are completely suspended during perfect sleep, some of them, when the sleep is less profound, remain active; a condition of that system which is remarkable in *somnambulism*, in which state the organs of active motion are especially excited.

"I have seen her rise from her bed, throw her night-gown upon her, unlock her closet, take forth paper, fold it, write upon it, read it, afterwards seal it, and again return to bed, yet all this while in a most fast sleep." Shakspere.

"The stories related of sleep-walkers are, indeed, of so extraordinary a kind, that they would almost seem fictitious, were they not supported by the most incontrovertible evidence. To walk on the house-top, to scale precipices, and to descend to the bottom of frightful ravines, are common exploits with the somnambulist; and he performs them with a facility far beyond the power of any man who is completely awake." Macnish.

These faithful pictures of the somnambulist were lately exemplified in a young woman, under the care of Mr. Pratt. The subsequent particulars of her case become the more interesting, as they not only point out a most successful mode of treatment, but they give a satisfactory explanation of the cause of this hitherto inexplicable disorder.[1]

Case communicated by Mr. Pratt.

"About two years since, my neighbours were greatly alarmed from a report that a woman walked, in her sleep, on the tops of the houses every night. Some were inclined to believe it was a ghost, on account of the agility with which the figure passed over parapets, roofs, and other places, which it was perfectly impossible for a person to accomplish without labouring under some extraordinary excitement. The whole of my neighbours, from nearly a quarter of a mile round, having watched their servants, I considered it to be my duty to do the same; though I believed it to be impossible that either of my servants could be the person, as the room in which they slept had, besides the windows, a door leading to the roof, only two feet square. I placed myself in a corner of the room at 11 o'clock, P.M., and, as it struck twelve o'clock, one of the servants rose up in bed, in her night-dress, and, in the most skilful manner, stepped over jugs and basins, full of water, that had been purposely placed to intercept her progress, but she succeeded in getting through the small door in the roof. The night was dark; there was a fall of sleet and rain, and a high wind. She continued for fifteen minutes running and stepping from roof to roof, as if she could clearly see her way. Several nights I observed the same thing; after which I locked the door in the roof. This caused her great anxiety; she left the room and walked about the house. On the following day she appeared to be greatly depressed in spirits; she then acknowledged to me that she had been in the habit of walking in her sleep since her childhood; and she entreated me to allow her to continue to do so, for if she was prevented, she apprehended some bad consequences. I was, therefore, induced to allow her to follow her own inclinations, and, at the same time, to adopt a system of medical treatment for her relief.

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[1] "The remote causes of sleep-walking are so obscure, that it is seldom we are able to ascertain them. General irritability of frame, a nervous temperament, and bad digestion, will dispose to the affection. Being a modification of dreaming, those who are much troubled with the latter will, consequently, be most prone to its attacks. The causes, however, are, in a great majority of cases, *so completely unknown, that any attempts to investigate them would be fruitless;* and we are compelled to refer the complaint to some idiosyncrasy of constitution, *beyond the reach of human knowledge.*"—Macnish.

"On examining the heart I found its action very much increased, and the arterial pulse irregular. After telling her to go quickly up and down stairs, and then to return to bed, the action of the heart was greatly accelerated, accompanied with such difficulty of breathing as to alarm those who were present. This disturbed state of the heart appeared to me to point out the cause of the derangement in the cerebro-spinal system, and to illustrate an interesting pathological fact.

"The treatment I employed was to apply three leeches to the region of the heart, sinapisms to the feet, and a dose of James' Powder at bedtime. After adopting this treatment for a few days, all the symptoms were greatly alleviated, and by the subsequent use of the Steel Pill she perfectly recovered."

Somnolency.

Contrasted with insomnolency are somnolency, coma, catalepsy, and syncope,—all conditions of the cerebro-spinal system indicating a *diminution* in the vigour of the heart.

Somnolency may be considered as a modification of sleep, or a deviation from the healthy state of that function; and in the same manner, as an increase in the proportion of the arterial blood causes wakefulness, so in somnolency or lethargy there is an increase in the proportion of the *venous* blood in the cerebro-spinal system. The first of these conditions of the brain is diagnostic of disease of the systemic heart, and the second points out some disturbance in the pulmonic heart.

Case.

A man, about the middle period of life, suffered from a disease of the right heart, which ultimately caused his death. During the latter months of his illness, he sometimes remained for several days in a state of lethargy, and, in the intermediate times, his intellectual powers were restored.

"The sleeping girl of Montrose."

"A girl, eighteen years of age, after having suffered three weeks from a nervous fever, awoke one morning with a profuse bleeding from the nose, which continued for several hours. The loss of blood must have been considerable, but the exact quantity could not be ascertained. Immediately after this took place, she fell into a comatose state, and, two days after, she was conveyed to her father's house, where she remained fifteen hours in the same state: she then awoke and took some food, complaining only of weakness.

"About fifteen hours afterwards she again became comatose, and continued in that state seven days and seven hours, without taking any kind of nourishment, and without the evacuation of either fæces or urine. After this period some food was given, by putting the patient's hand with a spoon to her mouth, and pouring it in, by which she was enabled to swallow, although still comatose: the hand remained in the same situation till put back by the assistant. In this state she continued thirty days more, receiving nourishment in the same manner occasionally, and passing her fæces and urine involuntarily.

"On the thirtieth day, some signs of hearing were evident, and about half-past ten at night she was lifted from her bed, and in the course of a few minutes all her faculties returned."

Edin. Med. and Chir. Journal.

Syncope.

Fainting.

Whenever there is any impediment to the free egress of the arterial blood from the left heart, or when a large quantity of the general mass of blood has been abstracted from the system, the supply of the vital fluid to the brain, under these circumstances, being diminished, there follows languor, loss of sense, loss of voluntary motion, and *syncope*.

Most of the morbid changes in the left heart must, it is evident, produce a diminished impetus in the current of the systemic blood by the imperfect manner in which such structural changes cause the heart to propel the blood into the large arterial trunks.

In diseases of the heart, besides that series of symptoms which arises from a diminished supply of arterial blood to the cerebro-spinal system, there may also be symptoms produced by the *venous* blood not having its free ingress from the *venæ cavæ*, and its egress into the pulmonary artery from the right heart. These causes of a languid circulation will happen, whether the structure of the valvular apparatus of either heart be injured, or whether their parietes be, from any structural change, unable to propel the blood with its wonted vigour.

Syncope varies much, both in degree and in duration, in the maladies of the heart. Sometimes it characterizes a mere temporary disturbance in the heart's action, of which we frequently see examples in hysterical women. In many instances of syncope the beatings of the heart and arterial pulse can scarcely be perceived; life appearing to be extinguished. Frequently those who die from cardiac disease expire in consequence of a paroxysm of that syncope to which they may have long been subject, continuing beyond its usual time; the heart not being able to overcome some mechanical obstruction to the circulation.

Though, when long protracted, it may prove fatal, yet syncope sometimes continues such a length of time, that the disordered condition of the heart producing the fainting state is apparently relieved by it.

Syncope I have pointed out to be one of those acts which Nature herself resorts to, for relieving certain disturbances of the circulation, and it is often successfully employed artificially in order to effect a similar purpose. Syncope has so powerful an influence in mitigating some disorders of the heart, that if there could be discovered any safe mode of keeping a person in a prolonged state of fainting, we might, perhaps, be thus able to remedy many diseases, depending upon an altered condition of the circulating system, which are at present considered beyond the reach of art.

To effect this purpose, it has always appeared to me, that the ingenious "cupping-boots," invented by Junod, might be advan- *Gazette Médicale.*

tageously employed. Abstracting by means of that instrument a quantity of blood from the trunk of the body to the extremities sufficient to cause fainting, that state might be produced to any degree, and prolonged to any length of time, so that a powerful effect upon the heart might be thus produced.

Coma.

Coma—its nature.

Coma is so nearly allied to somnolency, that the two states of the sensorium may be considered as the continuous links of a chain; being in all probability only different degrees of the same pathological conditions of the cerebro-spinal system. In coma, the functions of the heart are so impaired, that the whole nervous system appears to be wanting in its due supply of arterial blood, and consequently all the functions both of animal and organic life to have become more or less enfeebled.

Though a person in a state of coma appears to be only in a profound sleep, yet it is difficult, if not impossible, to awake him; a circumstance which distinguishes coma from natural sleep.

Causes of coma.

A comatose state may be produced either by physical or by moral causes. It may be caused from the heart not being able to circulate the blood, either in consequence of a morbid change in its structure; from a want of sufficient muscular power; from a diminution in the quantity; or from a change in the quality, of the vital fluid; in all which cases coma is "sometimes accompanied by convulsions or spasms, at other times with a delirium alternating with convulsions." Parry.

Fear and sudden grief, and also neurotics, are a frequent cause of coma; in these cases the mental excitement produce a congestion of blood within the heart.

If we can suppose a state of the heart, where there is already within its cavities too much blood, any convulsive movement, in place of relieving such congestion, would inevitably increase it, and aggravate the symptoms. Accordingly, whenever the heart is congested to such a degree that it is incapable of emptying itself sufficiently, there comes on, in place of syncope and convulsions, a state of coma, which in some instances continues an extraordinary length of time, the circulation being only vigorous enough to preserve organic life. Finally, the general mass of blood is so greatly diminished, becoming so imperfect from the enfeebled state of respiration, and from not receiving the requisite supply of chyle, that the heart is sooner or later enabled to perform its functions more vigorously; the cause of the retarded circulation is thus gradually removed, and ultimately the sufferer awakes in a state of comparative health.

In some instances, the congestion of the heart, and the comatose state which accompanies it, take place to such a degree as even to destroy life; and, as I observed, when speaking of the influence of the mind upon the heart, that in those instances where persons have expired from sudden grief, their death has been caused by cardiac congestion.

A long-protracted comatose state may not be unaptly compared to *hibernation* in animals. If such a state could only be artificially produced in man, might not many of his ailments be thus mitigated, especially those of the circulating and nervous systems? Indeed, I am convinced that the prolonged state of *syncope*, and great inanition which often supervene excessive hæmorrhages, are sometimes the means of curing the diseases by which the hæmorrhage is accompanied.

Catalepsy.

Apoplexia cataleptica.

Catalepsy appears to be nearly allied to coma; and of all the imperfections of sleep it approaches nearest to death: for during the cataleptic paroxysm, not only the whole of animal life ceases, but organic life can scarcely be said to exist.

Of the precise nature of catalepsy little is understood; but it appears to me that the most remarkable symptoms of that state are referable to changes of the circulation in the cerebro-spinal system, and that these usually depend upon changes in the condition of the heart.

CHAPTER XVII.

SYMPTOMS DERIVED FROM THE CEREBRO-SPINAL SYSTEM.

Subject continued; apoplexy; epilepsy; hysteria; convulsions; chorea; tetanus and cramp; neuralgia; ringing in the ears; and ocular spectra.

Pursuing our inquiries regarding those symptoms in diseases of the heart which are derived from the influence of changes in the circulation on the cerebro-spinal system, we come next to consider the nature of the different kinds of *fits*, or paroxysms which have been enumerated in systems of nosology—such as apoplexy, epilepsy, hysteria, convulsions, and syncope—all of which depend either upon some idiopathic affection of the cerebro-spinal system, or they are *symptomatic* of a primary affection of the heart, "agreeing with each other only in their final influence upon the functions of the brain." Abercromby.

However much the different kinds of fits may resemble one another, yet attempts have been made to draw a distinct line of demarcation between each; but if the symptoms which are manifested in each species be examined minutely, although the general assemblage of these symptoms may be different, yet there is no one symptom that does not sometimes occur in all of them.

In the different kinds of fits are to be found every possible combination of changes, both in the functions of the brain and spinal cord, affording examples of all those classes of symptoms of a disordered heart which have been enumerated; at the same time, the portion of the cerebral system affected in particular disorders of the heart, pathological research has not yet revealed; and all the evidence we possess on this subject goes only to prove that certain changes do take place in the functions of the nervous system from changes in the functions of the heart.

The descriptions given of *apoplexy* in particular, and the various *species* of that disease which nosologists have enumerated, offer a striking proof of the error of grouping together those diseased conditions of the nervous system, which may be the effect either of some primary disorganization of the brain, or, what I believe to be far more frequent, of diseases of the brain arising from the circulation in the head being disturbed, in consequence of a disorder of the heart. The phenomena accompanying these two distinct conditions of the brain must be very different, and it is reasonable to surmise that the symptoms caused by a change in the structure of the brain cannot have the same influence on the general system, as those changes which are caused by a disordered heart.

Until the works of Portal, Corvisart, and Laennec appeared, it seems never to have even been conjectured that changes in the cerebral circulation could depend upon, or arise from changes in the functions of the central organ itself. Although the co-existence of an apoplectic fit with a diseased heart, in a large proportion of cases, has since been universally admitted, still no one, as far as I know, has attempted to give any explanation of those peculiar arrangements of the vascular system by which so important a relation between the nervous system and the heart is established; and even one of the latest writers on this subject observes:—"There is reason to believe that certain apoplectic affections are connected with a disease of the heart, *the nature of which is extremely obscure.*" But now that the peculiarities of the circulation in the brain have been shown to be so completely dependent on the heart's action, and the relation of the brain and heart to be depending on the blood, the pathological phenomena of the two vital organs can, I think, be very satisfactorily explained.

Abercromby.

Symptoms of the two classes differ.

The symptoms which accompany these conditions of the brain —the idiopathic and the symptomatic—though some of the symptoms may be common to both, yet each assemblage, taken collectively, must be of a very different character; for it has been already mentioned that the symptoms of a disorganization of the brain, or of its meninges, cannot have the same influence upon the economy, as those changes in the circulation within the head which are caused by a disordered heart.

The first class of symptoms, or of those arising from an idiopathic affection of the cerebro-spinal system, I am not going now to discuss; but will endeavour to investigate only those which are developed in that system, when the heart's functions are disturbed,—symptoms which have never been enumerated nor classed together as appertaining to the semeiology of the heart.

Those symptoms caused by a diseased heart.

Such symptoms, I think it will appear, must necessarily be of two kinds: one caused by changes in the *systemic*, and the other by changes in the *pulmonic* heart. This view of the nature of the different kinds of apoplexy, affords a satisfactory explanation of the various and apparently incongruous assemblage of symptoms of these diseases which have been grouped together by nosologists; and also accounts for the inconsistent subdivisions and number of species which they have enumerated.[1] It is clear that, as one part of that classification includes certain symptoms caused by a change in the circulation of the *venous* blood within the head, another includes a series of symptoms produced by a change in the circulation of the *arterial* blood, thus confounding two perfectly distinct conditions of the nervous system.

Apoplexy may be either venous or arterial.

That one state of the cerebral circulation produced by a disorder of the *right* heart, and another by a disorder of the *left*, may either of them, singly or combined, cause apoplexy, can be clearly demonstrated by the differences of the symptoms in the two kinds of the disease; so that according to the character of these symptoms will the seat of the disease in each heart be indicated.

An important induction from this view of the pathology of apoplexy is, that the general system of treatment ought to be entirely different in the two species of the disease: thus affording a satisfactory explanation of the remarkable discrepancy in the principles of treatment which have been generally recommended.

[1] Table of the Different Species of Apoplexy.

Apoplexia	Sanguinea.	Apoplexia	Catarrhalis.
,,	Serosa.	,,	Hereditaria
,,	Simplex.	,,	Spasmodica.
,,	Inflammatoria	,,	Convulsiva.
,,	Plethorica.	,,	Hysterica.
,,	Arthritica.	,,	Nervosa.
,,	Rheumatica	,,	Fulminans.

But whilst such a distinct line of demarcation can be legitimately drawn between an *arterial* and a *venous* apoplexy, it must not be denied, that examples may be found where these two states of the vascular system co-exist at the same time.

Analogy of apoplexy, &c.

In confirmation of the preceding views, I may observe that the condition of the vascular system of the brain in apoplexy, appears to bear a very strong analogy to an organ when *inflamed* during the acute and chronic stages of inflammation. As in *arterial* apoplexy there is an increased quantity of arterial blood in the brain, so during the *acute* stage of inflammation there is an increase of the arterial blood in the inflamed part; and, as in the *venous* apoplexy, where there is an increased proportion of venous blood within the head, so in *chronic* inflammation the venous system of the part affected has become congested, and the arterial circulation so languid, that the diseased organ appears to be congested entirely with venous blood.

This analogy may be traced still further by comparing the most appropriate systems, for the treatment of the two forms of apoplexy, with those which are employed for the treatment of inflammation in its two opposite stages.

In acute inflammation, as in *arterial* apoplexy, a depletive treatment is applicable; whereas, when the inflammation is passive, as in *venous* apoplexy, evacuating remedies afford comparatively but little relief, stimulants being most efficacious.

Venous apoplexy.

On reviewing the different accounts which have been given of the nature of apoplexy, it will be found that some histories of the disease dwell more especially upon those symptoms which mark the disturbed state of the *venous* circulation, or of a disorder in the *right* heart; and that in other histories of this disease, those symptoms are chiefly described which characterize a disturbance of the *arterial* circulation, with some disorder of the *left* heart.

The diminished vigour of the intellectual powers; the disposition to sleep, and lethargy; the livid and turgid countenance from over-distention of the subcutaneous veins; the embarrassed respiration; the slow and easily compressed pulse, are all symptoms caused by a disturbance in the circulation of the *venous* system.

Arterial apoplexy.

In those cases of apoplexy in which the condition of the sensorium is altered from an increased proportion of the *arterial* blood, there is giddiness, headache, vertigo, ringing in the ears, ocular spectra, insomnolency, mental irritability, flushed countenance, along with a vigorous action of the heart, and a full, throbbing arterial pulse,—symptoms all indicating a disorder of the left heart.

Different systems of treatment explained.

This view of the nature of apoplexy, and of the two distinct and very different conditions of the cerebro-spinal circulation in each type of that affection, not only affords a most useful contribution to the catalogue of *symptoms* in the diseases of both hearts; but it reconciles the contradictory accounts which have been given of the history of the symptoms, and, at the same time, explains the apparent inconsistency in the different modes which have been recommended for treating apoplexy. I refer to that system of treatment, which consists in the use of *depletive* means, and to the other, wherein the propriety of exhibiting *stimuli* is advocated.[1]

To affections of the systemic heart the depletive system of treatment is undoubtedly applicable; but, where the pulmonic heart is gorged with blood, a depletive system is to be adopted with great caution, as, by still further reducing the vital powers, the venous congestion will be increased; whereas the exhibition of stimuli or *cardiacs*, properly so called, by invigorating the heart, will enable it the better to propel the blood into the arterial system. At all events, the effects of opening the temporal artery, or the jugular vein, both of which have their advocates, must be very different in the two forms of this disease; for whilst, in venous apoplexy, abstracting a certain quantity of venous blood might relieve the right heart, and the venous congestion in the head, the abstraction of arterial blood would diminish the vigour of the heart, and, by rendering the arterial stream in the head less vigorous, the congestion of the venous system would not be diminished.

The abstraction of a certain quantity of blood, I have said, may relieve congestion of the right heart. Experiments on animals have distinctly shown how, when the pulmonic heart has become so congested that it ceases to beat, its pulsations are immediately restored by venesection; so that the abstraction of a limited quantity of blood in *venous* apoplexy will enable the heart to propel its contents with more force. The quantity of the vital element, however, to be abstracted ought to be so moderate that the future vigour of the circulation may not be diminished.

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[1] "The brothers Montaine divided sanguineous apoplexy into arterial and venous, and they endeavoured to distinguish them from the other kinds."—*Traite de l'Apoplexie.* Lyons, 1811

Some persons are predisposed to apoplexy.

The common remark, that those who have *short necks* are particularly disposed to apoplexy, is certainly correct. But, it is surely illegitimate to suppose, that it is merely the shortness of the cerebral arteries which predisposes such persons to apoplexy. The difference of an inch in the length of a tube cannot produce any appreciable alteration in the current of a fluid passing along it. To me it appears that those who have short necks have usually a large chest—such a form of the chest as is very often found in those who have a diseased heart. There is a *harmony* in the organization of the human frame in the different races of mankind, and there are particular forms of the body, all which have some special character in the different parts of the same person. In one person we observe the nose, the lips, the brow, the cheeks, and the chin broad and flat; in another, all these features are angular: hence we may infer, that the man with a *short neck*, and a large capacious chest, will have also short, thick hands and feet, which, as Cullen observed, are characteristic of plethora. "I have remarked, in several instances, that those having their *feet* and *hands* shorter than in the *usual* proportion to the rest of the body, were those liable to a *plethoric* state of the lungs."

Cullen.

By the early writers, an apoplectic fit had always been considered to be the effect of some mechanical *compression* upon the brain; but the question has since been much discussed, whether or not the brain can be compressed?

The incompressibility of the brain.

It appears extremely probable that those who have attempted to explain various phenomena in the diseases of the cerebro-spinal system, by attributing them to *compression*, have been led to form that opinion from the effects of those injuries of the brain which cause more or less compression;—such injuries as depress a portion of the bony cranium, or cause the effusion of blood in the medulary pulp.

But the varied changes in the *proportions* of the arterial and venous bloods within the head, and the changes in the velocity of their currents, appear to me to explain satisfactorily the morbid phenomena of the nervous system, which have been attributed to a compression of the brain; it is not, therefore, necessary to assume that the phenomena, in different disorders of the heart, are the effects of compression on the brain.

That changes in the proportion of the two bloods cause disturbance in the functions of the brain, we have ample proofs. It is no less evident, that changes in the *momentum* of the blood within the head, will produce changes in the functions of the brain distinct from those which are caused by differences in the proportions of the two bloods. The most remarkable of these changes are exemplified in sleep, and in all its varieties wherein there is a diminution in the velocity of the circulation; and also in changes in the position of the body; as is often felt when stooping forward for a time, by which the weight and velocity of the column of blood is diminished, thus causing giddiness and stupor.

Viewing the contents of the cranium as a physical apparatus, it is apparent that its construction is such that all compression of its contents is carefully guarded against. "The head, being a close, bony cavity, is not susceptible of atmospheric pressure; and though the quantity of blood may vary in other parts of the body, it does not do so in the head, where the vessels are in a similar position to that of a syphon in action. The arteries of the brain, not having to sustain the same outward pressure as the other parts of the body, are considerably weaker; whilst the veins are placed in grooves of the bones and have a strong covering, so that they cannot collapse by any sudden tension of the arteries, as other veins would do, and thus they are singularly adapted for the preservation of thought and life."

Hogg's *Elements of Natural Philosophy.*

"Unless," observes a learned author, "there has been a rupture of the vessels and extravasation of the blood, no change whatsoever in the state of the vessels can be distinguished; because the medullary matter of the brain is not compressible like a piece of sponge or cork, the pores of which are filled with air. Unless the medullary matter of the brain could, by the force of the circulation, be squeezed into a smaller bulk, it is evident there can be no sensible and general dilatation of the blood vessels."

Monro.

"To prove that the utmost force of the circulation is not capable of compressing the substance of the brain into a smaller bulk, I put large pieces of the brain into a glass decanter, and filled it with water to the middle of its neck. I then tied an inflated bladder on the mouth of the decanter, and did not find, on squeezing the bladder, that the water sunk in the neck of the decanter, which it would have done if the brain had been evidently compressible by such a force."

Monro on the Nervous System, 1783.

To illustrate the same views, Sir A. Cooper "applied the trephine to the cranium of a large dog, and took out a portion of the bone. I then, with the handle of a knife, separated the dura mater from the bone. Until I had done so, I found that I could make no impression on the brain. I then pressed upon it with my finger. At first the animal did not seem to feel it; but upon pressing more, it produced pain and irritation, and the dog endeavoured to avoid us. Upon still increasing the pressure he became comatose, and fell down. I kept him in that state for five or six minutes; upon removing my finger, he got up, turned round two or three times from giddiness, and then walked away apparently little worse for the operation."

Sir A. Cooper's *Lectures on Surgery.*

Admitting that the whole of the contents of the unyielding cranium are not susceptible of being compressed, yet we know that changes in the circulation of particular portions of the brain are constantly taking place. In those diseases, where the circulation in a particular part of the brain is disturbed, we can conceive how, when the due balance between the venous and the arterial circulation is destroyed, only that portion of the brain to which these vessels belong will be altered, and have its functions deranged. "Therefore," observes Monro, "where the blood is extravasated, it is most absurd to adopt the supposition that the white substance of the brain was compressed into a much smaller bulk, and had lost as much of its bulk as was equal to the bulk of the blood effused, instead of which it is evident that as much blood as a 20,000th part must have passed out of the head as was effused; or, if a part of the brain be inflamed and its vessels enlarged, the branches of the vessels in the rest of the brain must be pressed into a smaller bulk, and must send out of the head, by the veins, as much blood as had been added to the inflamed part."

"It may be also observed, that as the solid matter of the brain is not elastic, like compressed sponge, the general size of the blood-vessels of the brain cannot be diminished. Hence the vessels of the brain cannot be dilated or contracted, like those of the external soft organs; although an increased impulse of the blood in the arteries may quicken the motion of the blood within the head, it cannot add sensibly to the quantity of it; and, on the other hand, that opening the corresponding veins cannot diminish sensibly the quantity of it." Monro.

In concluding this subject, I may observe, that the changes in the circulation both of the arterial and venous blood within the cranium, opens an important field of inquiry; more especially, as in almost every disorder of the heart, the cerebral circulation undergoes changes either in the proportions or in the momentum of the two bloods. It is probable, as I have said, that, as pathological science advances, we shall be able to refer the morbid changes of particular portions of the nervous system to particular disorders of the heart.

Hysteria.

Hysteria

What has now been said of the nature of apoplexy is, in many respects, applicable to other fits; especially to those of *hysteria*, *epilepsy*, and *convulsions*; all of which may be considered as "different links of one chain, caused by changes in the circulation of the blood within the head." These changes in the circulation of the cerebro-spinal system, I shall also endeavour to show, are, at least in many instances, caused by a primary affection of the heart, and may therefore be, with propriety, added to the catalogue of *symptoms* of a disordered heart.

Considered as one of the neuroses.

The pathology of *hysteria* has never been very clearly explained; nosological writers have been satisfied with arranging it amongst *nervous* diseases, though it may be distinctly shown to be most commonly symptomatic of an affection of the heart: the various symptoms which characterize it being all referable to changes in the distribution of the blood in the cerebro-spinal system, and the hysteric paroxysm being always preceded or accompanied by palpitations more or less violent.

Amongst the more striking symptoms of hysteria may be enumerated palpitation of the heart, dyspnœa, involuntary movements of the muscles, temporary disturbance of the intellectual powers, screaming, sighing, sobbing, weeping, laughing; all these being instinctive acts of the economy, as I formerly said, which are employed by the *vis conservatrix* to restore a disturbed circulation.

The causes, too, which produce hysteria afford further evidence to prove that the primary affection is often seated in the heart. Mental emotions, particularly in persons of an irritable and easily excited temperament, most frequently precede the hysteric paroxysm.

There is still another and no less important source of evidence, that the heart is the organ which is often primarily affected in hysteria, in the medicines which are successfully employed for the treatment of hysterical affections; these all being such as are well known to act upon the organs of circulation—such as antimony, iron, copper, zinc, and all the antispasmodics commonly so called.[1]

Epilepsy.

Epilepsy.

Epilepsy is by no means an uncommon symptom in those affected with a disorder of the heart; and the circumstance of a person being subject to epileptic fits points out the propriety of examining the condition of the heart, in order to ascertain how far the fit depends on a disturbed circulation, and not upon any primary disease of the encephalon, or be symptomatic of some disorder of the abdominal viscera. "I have seen," observes Parry, "several instances in which epileptic fits immediately followed violent palpitation of the heart, which, in one of the cases, was excited by merely a disagreeable smell, and produced the paroxysm in a patient who was never previously so affected. It may, indeed, with great reason be doubted whether palpitation be not a prelude to the fit in most cases, although in many the approach of the paroxysm is so rapid that the true series of symptoms elude or escape observation." And again, he observes,

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[1] A remarkable instance of the power of imitation occurred at the Hospital of Harlaem, in Holland. A patient with epilepsy being admitted, was attacked with a fit, and many of the patients in the same ward were seized with an epileptic paroxysm.—*Van Swieten.*

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"That the cause of epilepsy is owing to the state of the circulation, is probable from the suddenness of the attack, and the perfect interval which exists between them, both which circumstances imply the operations of a fluctuating cause, which we cannot well conceive to be any other than one of those sudden changes which we see continually occurring in the sanguiferous system."

The convulsive movements which accompany the epileptic, as well as the hysteric paroxysm, must assist in restoring the circulation which in these affections is so manifestly deranged; for, as I have shown that in all disorders of the heart where convulsive movements take place, these movements must increase the quantity of blood in the left ventricle, so it may be expected that it will only be in those conditions of the heart, where there is a want of systemic blood, that convulsions will take place spontaneously, as a restorative or curative act of the economy.

I may here remark, that the cases of epilepsy, like those of hysteria, which are under the influence of medical treatment, have usually been relieved by such remedies as act upon the circulation, and of which many examples might be cited.

Convulsions.

Of that class of symptoms in diseases of the heart derived from the spinal cord, in which only the nerves of the *motor* column are affected, the most remarkable are *convulsions:* these take place occasionally in all the various kinds of fits, and in those too whose character seems perfectly different.

They arise from two causes.

Hippocrates.

Convulsions may be caused either by a diminution or by an increase in the circulation, or, as was observed by the father of medicine, "convulsions may arise either from *evacuation* or from *repletion*."

Convulsions from depletion.

In most cases of those convulsions which arise from "evacuation," or when such a diminution has taken place in the quantity of blood within the heart as to cause syncope, general convulsive movements succeed the loss of sense and voluntary motion: the convulsions are in this case resorted to by the economy in order to increase the vigour of the enfeebled heart by increasing the quantity of its systemic blood.

It will be likewise found, that in all those affections of the heart, which are accompanied by fits of *syncope*, that convulsions generally succeed the fainting state; the *musculo-cardiac* function, under such circumstances, being resorted to by the economy, to invigorate the central organ, and thus cause more blood to be impelled into the cerebro-spinal system.

Convulsions from repletion.

The convulsions from "repletion" are caused by those conditions of the nervous system where there is a congestion of blood in the cerebral vessels,—in many of such cases the functions of the heart have been primarily disturbed, so that apoplexy, hysteria, and epilepsy are all accompanied with convulsive movements. The convulsions which accompany immoderate fits of laughter are sometimes so violent as to create fatal congestion of the heart.

Involuntary movements, especially of the limbs, or twitchings in particular muscles, are by no means unfrequent during imperfect sleep, as happens when the circulation has been disturbed by a full stomach, by flatulence, or by the presence of indigestible food; and often those with a disorder of the heart have their sleep, which usually was very imperfect, accompanied by convulsive movements, of which they were not themselves conscious.

In chorea.

The action of the muscles in *chorea* affords another example of involuntary muscular movements accompanying a disordered heart. Although we may be unable to give a satisfactory explanation of this symptom, it has been distinctly shown that some cases of chorea are accompanied by a disturbance of the heart; and that they have been relieved by blood-letting and antimonials. Copland.

Other cases of chorea arise from a disordered state of the alimentary canal, and are cured by purgatives. Hamilton.

It is a remarkable phenomenon, that the unceasing movements of the muscles, which take place during wakefulness in those affected with chorea, should cease altogether during sleep.

In tetanus.

Contrasted with the phenomena which accompany chorea, are those of *tetanus*, wherein the contraction of the voluntary muscles is permanent. The pressure which is caused by such muscular contractions must, by impeding the free transit of their blood, have a powerful influence on the general circulation, especially on the condition of the heart.

Paralysis.

Paralysis;

There is another affection of the organs of active motion symptomatic of a disordered circulation, and which is of a very opposite character to convulsions; the muscles in such cases losing to a greater or less degree their contractile power, and sometimes becoming completely *paralyzed.*

motor column affected in.

This affection of the *motor* column of the spinal cord may be observed in those cases of a disordered heart arising from violent mental emotion, and from the abuse of narcotics; the impaired power of motion remaining a very lengthened period in some cases, and in others being merely transitory.

Case.

A lady, who had a *congested heart* caused by grief, after losing for some time the power of motion and of feeling in one side, the face and upper extremity of the body recovered, and at the same time the lower extremity of the opposite side became affected, and thus she was disabled from using both of the lower limbs.

Both motor and sensory columns affected. Case.

Sometimes the *motor* column of one side and the *sensory* column of the opposite side, become affected in the same manner.

A gentleman was attacked with a *paralysis* of the *left* side of the body; on the following morning he had an apoplectic fit, during which the whole of the *right* side was in perpetual *convulsions.*

A similar condition of the *motor* column of the spinal cord may be observed in only one, or in several nervous trunks at the same time.

Case.

A young lady, suffering from a disordered heart, lost the power of moving the right hand to such a degree that she was quite unable to move her fingers, but the power returned by employing cardiac remedies.

Neuralgia.

Altered sensibility.

Another class of symptoms, which are met with in disturbances of the heart, arise from affections of the nerves of sensation, or of the *sensory column* of the spinal cord; these nerves in one class of cases losing, more or less, their sensibility, and in another class their sensibility is morbidly increased.

In some cases of paralysis, besides the loss of motion, there is also the loss of sensation, both columns of the spinal cord being simultaneously affected. "In palsy the loss of *motion* is often accompanied with a loss of *sense*." Cullen.

Sensibility impaired.

Impaired sensation of the *sensory* nerves happens in those affections of the heart where so great a disturbance of the circulation has been produced that some of the functions of the whole cerebro-spinal system are disturbed. In other cardiac diseases, the powers of only a limited number of these nerves are impaired.

Case.

A young woman, afflicted with hysteria, entirely lost the sense of touch in one of her hands and fingers, whilst she retained the powers of motion.

Increased sensibility.

A morbid sensibility of the *sensory* nerves is by no means of rare occurrence in disorders of the heart.

Case.

An athletic youth complained of tingling sensations in several of the fingers of one of his hands; after trying various means ineffectually I was led to examine the state of the circulating organs. The radial pulse being small, and the cardiac pulse vigorous, it appeared not improbable that the sensations in the fingers might be symptomatic of a disturbed circulation affecting, in a particular manner, the spinal cord. Leeches were applied to the cardiac region, and, with the addition of some antimonials, all the symptoms were quickly relieved.

Neuralgic pains.

A great variety of painful feelings, such as those anomalous sensations in the arms, neck, and chest, which constitute *angina pectoris*, are all referable to a disordered condition of the sensory column of the spinal cord, and have been considered to be symptomatic of an ossification of the coronary arteries.

Tic douloureux.

Painful affections of a particular nerve, especially of the different branches of the fifth pair, may, in some instances, be observed to be symptomatic of a disturbed heart.

Case.

A woman complained during several years of a painful affection of the branches of the facial nerve of the left side, which had all the character of "tic douloureux." An increased impulse of the heart led me to apply leeches upon the precordial region; by which, along with the administration of antimonials, the

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Ringing in the Ears.

Tinnitus aurium.

Of the sympathetic affections of particular nerves in diseases of the heart, there are none more remarkable than those of hearing and of sight; and, although those authors who have professedly treated of the diseases of the ear and of the eye, have noticed the affections, yet no one, as far as I know, has ever pointed out the important pathological fact, that morbid sounds in the ears and false images before the eyes are *symptomatic* of a disordered heart, until I published, some years ago, two papers on these interesting subjects. *Lancet*, 1834.

Of all the symptoms derived from the cerebro-spinal system characteristic of a disordered heart, morbid sounds in the ear may be deemed one of the most remarkable.

Causes of tinnitus:

The transitory ringings in the ears, caused by violent mental emotion, offer an illustration of the temporary effects of a disturbance in the action of the heart upon the organ of hearing; and, when there is a permanent derangement in the circulation, it can then be readily explained, how the disturbed state of the ear should also become permanent, and afford a most unequivocal symptom of a disordered heart.

Morbid sounds in the ear may be caused, either by a diminution or by an increase in the proportion of arterial blood in the brain.

by a diminution of blood;

That sounds in the ears may be produced by a *diminution* in the supply of the arterial blood to the brain, is proved by these sounds being often caused by large depletions; and they are well known to be the signs of approaching syncope during the operation of blood-letting. The *tinnitus*, which accompanies some of the diseases of the heart, may therefore be sometimes caused by the proportion of the arterial blood in the brain being diminished.

These morbid sounds in the ear are frequent in persons of a plethoric habit, and who have a vigorous circulation.

Effect of the contact of the auditory

That morbid sounds are also produced by the movements of the blood-vessels of the ear, is extremely probable, from what is known of their arrangement. "The basilar artery furnishes the internal audative, a branch which passes into the internal audative canal, to be distributed on the internal ear, and is accompanied with the nerve of hearing." The close contact of the artery and the nerve, and the movements of the artery being communicated to the organ of hearing by the solid bones through which it passes, have been considered sufficient to influence the functions of the nerve, and thus cause sounds.

artery and nerve.

Haller.

Character of the sounds.

The sounds which are symptomatic of a disordered heart vary in their character. They are sometimes perceived in both ears, but more generally in only one of them; they are usually unremitting, they vary in intensity, and are louder when in bed, so much so as frequently to prevent sleep; and they may continue for months or even years.[1]

Those who are thus affected compare the unnatural noise to the rushing of waters, the roaring of the sea, the ringing of distant bells, or to the sound of boiling water, and such like.

At the same time that a person complains of such sounds, there is no change experienced in the functions of the ear, as far as regards its power of distinguishing differences in the intensity of the natural sounds.

Case.

A lady was suddenly thrown into deep affliction, which was immediately followed by a violent palpitation of the heart. About fourteen days afterwards, the palpitations not having subsided, she heard a noise in one ear, which she mistook for the sound of carriages passing in the street. The noise continued, with remissions, and she sometimes perceived it in both ears.

Morbid sounds in the heart.

Besides those which are produced by changes in the circulation in the brain there are sounds, which originate in the heart itself, sounds which are caused by alterations of its structure, and which are conveyed to the organ of hearing through the medium of the bony framework of the chest and head.

When a person is in health, and the action of the heart tranquil, its movements are quite imperceptible to himself; but whenever its impulse is increased beyond a certain limit, and more especially when the bony parietes of the chest are not loaded with soft parts, then he may perceive both the impulse and the sounds of the heart, particularly when he is in bed.

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[1] Abercromby narrates a case of a person who was *deaf* when he sat up, but could hear when he was placed in the horizontal posture.

In some diseases, especially in those where the *auriculo-ventricular orifices* are changed in their form, entirely *new sounds* are produced by alterations in the currents of the blood. These sounds are sometimes so intense, as to be conveyed to the ear of the patient, so that when he is perfectly tranquil, and his mind undisturbed by surrounding objects, the peculiar sounds of the diseased heart become distinctly audible to himself, and are referred by him to some sonorous body at a distance.

Case communicated by Mr. Kiernan.

A countryman, in whom the auriculo-ventricular opening of the systemic heart was not larger than the diameter of a carotid artery, was, during several months before his death, much disturbed when in bed by a noise which he imagined to be the barking of a dog at a neighbouring farm-house. On coming to London, he was surprised at being disturbed by what he supposed to be the barking of the same dog; but his surprise ceased when it was explained to him that the sound originated in his own chest, the "bellows-sound" being, in his case, remarkably strong.

Ocular Spectra.

Musci volitantes.

False images appearing before the eyes, and various imperfections in the functions of the *retina* form another class of important *symptoms* in the diseases of the heart.

Many who are suffering from a permanent disorder of the heart have peculiarities in their sight, which are caused by changes in the circulation within the head; so that certain disturbances in the functions of the retina become as important diagnostic *symptoms* in diseases of the heart as those which take place in the organ of hearing.

The changes in the functions of the retina, to which I allude, are *false images*, or the appearance of bodies floating before the eyes, *sparks of fire*, *dimness of sight*, even to blindness; all which symptoms may either exist separately, and in one or both eyes, or they may be combined with other disturbances in the cerebro-spinal system.

Case.

My attention was first directed to these affections of the retina

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as *symptoms* of a disordered heart in a young lady who was suffering from ocular spectra; not being able to refer this affection either to congestion in the brain, to a disturbance in the digestive organs, nor to any change in the eyes themselves, I found that the action of the heart was considerably disturbed; and the spectra disappeared when the healthy state of the circulation was restored by appropriate remedies.

Case.

A man who had a diseased heart for several years, brought on by running so violently that he fell down senseless, met some time afterwards with a severe affliction by which he was greatly excited, and which was immediately followed by a dimness in the vision of his right eye. Fifteen months subsequently, the sight was in the precise condition in which it was at the commencement of the disease; the sphere of vision not being altogether destroyed, so that he was still able to distinguish a small portion of any object.

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The "dizzy mist swimming before the sight" of the surprised lover, so admirably described by the dramatist, points out the immediate effects of a temporary increase of the heart's action on the cerebral circulation.

In congestion of the heart, ocular spectra are by no means unfrequent symptoms; whilst in febrile diseases the appearance of false images and of *sparks of fire* before the eyes are almost constantly present, especially during the acute stage of these maladies.

> "My undulating life was as
> The fancied lights that flitting pass
> Our shut eyes in deep midnight,
> When fever begins upon the brain."

Byron.

These affections of the retina may also depend upon a diminution of the arterial blood within the head: the most familiar illustrations of which are the ocular spectra which follow a large blood-letting, or a profuse spontaneous hæmorrhage.

Ocular spectra also arise from other causes besides a disordered heart. They frequently are symptoms of some disturbance in the digestive organs, of diseases within the head, in the eye itself, or in the parts immediately surrounding the globe.

Before concluding these observations on the symptoms of diseases of the heart which are derived from the cerebro-spinal system, I will briefly recapitulate the more important points which I have endeavoured to establish.

Recapitulation.

1*stly.* We have seen that many phenomena of the cerebro-spinal system are dependent upon the due circulation of the blood, and that all these phenomena are modified by disturbances in the action of the heart.

2*ndly.* That the changes produced in the cerebro-spinal system by disturbances in the circulation afford numerous and important symptoms in the diseases of the heart.

3*rdly.* That these symptoms are derived either from simultaneous changes in the functions of the whole nervous system, from changes in either of the nervous centres, or from changes in one portion of the brain or spinal cord.

4*thly.* That these symptoms are caused by changes in the circulation of the blood, either in the whole, or in particular parts of the nervous system.

5*thly.* That changes in the circulation are caused by alterations in the proportions of the arterial and venous blood, either in the whole, or in particular portions of the cerebro-spinal system.

6*thly.* That the various changes in the whole, or in portions of the cerebro-spinal system, during sleep and wakefulness, afford evidence of the influence of the circulation upon the functions of that system.

7*thly.* That, although some of the diseases of the cerebro-spinal system may be caused by morbid changes, primarily affecting that system, yet most of the diseases which are usually called "*nervous*" depend upon a primary disorder of the heart.

8*thly.* That different kinds of *fits* arise from disturbances in the cerebro-spinal circulation, caused by a disorder in the functions of the heart.

9*thly.* That one class of these fits arises from changes in the systemic, and another class from changes in the pulmonic, heart.

10*thly.* That pathological science has not yet advanced so far as to enable us to discriminate what are the particular disorders of the heart, which affect portions only of the nervous system, and which cause the particular symptoms; nor how it is that, in the case of several persons with apparently the same disturbed condition of the heart, one of them should have ocular spectra, another ringing in the ears, another convulsions, and another palsy.

11*thly*. That the various phenomena caused by modifications in the circulation of the cerebro-spinal system have a strict analogy to the effects of those medicinal substances which influence one portion only of that system.

CHAPTER XVIII.

SYMPTOMS OF DISEASES OF THE HEART DERIVED FROM THE RESPIRATORY SYSTEM.

Co-operation in the functions of the respiratory organs and the heart, both in health and in disease; intimate relation of these two organs; the particular symptoms in diseases of the heart derived from changes in the respiratory system; table of the symptoms; symptoms from changes in the pulmo-cardiac function; changes in the frequency, rhythm, and intensity of the breathing; pulmonary hæmorrhage; pulmonary apoplexy; sobbing; sighing; weeping; screaming; laughing; sneezing; hiccup; changes in the voice.

Reciprocal influence of the lungs and heart

WHEN investigating the semeiology of the heart, and prosecuting our inquiries into the influence of its disordered functions upon the different systems of the economy, of no less importance, than the cerebro-spinal system, is the *respiratory* system, with which the functions of the heart are so intimately associated in the healthy state of the body, and which is alike influenced by that system, when there is any disorder in the central organ of the circulation.

illustrated in their diseases.

Some of the disorders of the pulmonary apparatus, of which I am about to treat, may have been considered by pathological writers as symptomatic of a diseased heart; yet there are many other disorders which have been entirely overlooked; and, as I had occasion to mention, when pointing out the symptoms of a disordered heart, which are derived from the cerebro-spinal system, so I shall now endeavour to show, that there are pulmonary affections which, although they have been arranged in systems of nosology amongst the *idiopathic* diseases of the lungs, are in reality *symptomatic* of a disordered heart.

Some pulmonary disorders are symptomatic of a diseased heart.

Further, it will appear that, as many symptomatic affections of the cerebro-spinal system are successfully treated by those remedies which exercise their influence upon the heart, there are likewise many affections of the respiratory organs, which are relieved by those means which are known to have a direct or specific influence upon the organs of circulation.

Co-operation of the lungs with the heart in their diseases.

The diseases of the heart and lungs differ from the same class of ailments in all other organs; their motions being unceasing by the stimulus of the blood and of the air.

All the modifications to which the functions of the respiratory organs are liable are met with in disorders of the heart; and as the functions of the heart and lungs are so intimately associated in their healthy condition, no change, however slight, can take place in the functions of the one organ without producing some corresponding change in those of the other.

However great may be the influence which the functions of the lungs have upon the heart, in a still more remarkable degree do the functions of the heart influence the respiratory organs. The heart's actions are necessarily varying, from the almost constant changes required in the distribution of the blood to the various organs; but respiration is always equal and regular, unless when, from changes in the heart's functions, the pulmonary circulation suffers a corresponding change.

The lungs form the link between the right and left hearts.

As the two hearts have no immediate connexion with one another excepting through the medium of the lungs, the currents of the blood poured out from the systemic heart, however modified may be its currents, can have no influence on the right heart; at least, until the blood has passed through the whole capillary and venous systems. The lungs, indeed, form the great link between the right and left heart; a direct communication existing between them through the pulmonary vessels. This relation between the organs of circulation and respiration is strikingly illustrated by the effect which increasing the respirations has in increasing the action of the heart, and by the effect of quickening the respiration in increasing the circulation. See p. 153.

Both the lungs and heart are simultaneously influenced by mental emotion.

The influence of mental emotions on the heart causes a corresponding effect upon the organs of respiration:—

> "Not heart, but *breast did beat*,
> So much deranged all seemed;"

and, besides the change in the breathing, "the breathless anxiety" of those suffering from violent mental excitement, there are changes in the expression of the countenance which have been so faithfully delineated by Sir Charles Bell, and so admirably explained by the arrangement of the respiratory nerves.

Influence of the *pulmo-cardiac* function;

In the healthy state of the thoracic viscera, I have shown that the pulmonary vessels, besides conveying the venous blood from the heart to the lungs and again returning it oxygenated from the lungs to the heart, perform another very important function in the circulation, by receiving all such blood as the heart's cavities have not the capacity to contain, whenever the exit of the arterial blood from the left heart is impeded, or the return of the venous blood to the right heart is accelerated. This function of the lungs is perfectly distinct, and of a different character from the function of oxygenating the blood. It is purely a physical function, whereas the oxygenation of the blood is a chemical one. Hence life may be extinguished, or suffocation may be caused, either by the pulmonary circulation being stopped, producing pulmonary congestion, or by the inhalation of deleterious air destroying the vital properties of the blood.

symptoms from changes in it;

A knowledge of the *pulmo-cardiac* function enables us to explain many physiological phenomena by that function, and to account satisfactorily for many *symptoms* in the disorders of the heart—symptoms wherein modifications have taken place in the quantity of blood congested in the pulmonary vessels. It matters not what the disease of the heart is that causes an impediment in the pulmonary circulation; to effect such a purpose it is sufficient that the currents of the blood in the interior of the heart be altered, whether from a change in the cavities of the right or left heart, or in the cavities of both hearts.

We may, indeed, observe a chain of symptoms caused by disturbances of the *pulmo-cardiac* function, varying from a slight and merely temporary alteration of breathing, progressively increasing in severity until the impediment to the pulmonary circulation is so considerable, as to create much embarrassment in breathing, asthma, cough, and even pulmonary hæmorrhage.

connexion in the diseases of the lungs and heart.

From the account which has been given of the nature of the *pulmo-cardiac* function, it is quite evident that no change can take place in the action of the heart, without producing an immediate and direct influence upon the pulmonary circulation. If we examine the phenomena of life, every perceptible alteration in the functions of one of these two vital organs will be observed to be followed by some modification in the functions of the other. The heart cannot have its beats increased, however slightly, without respiration being proportionably quickened; nor can respiration be quickened without causing an increase in the action of the heart. And if such be the connexion in the healthy condition of these organs, what are we to look for, when either of them becomes diseased? Is it not, therefore, legitimate to conclude, that the same co-operation and dependence of the heart upon the lungs, and of the lungs upon the heart, so remarkable in health, will be developed whenever the functions of either of these organs are disordered?

The truth of this induction receives additional confirmation from many pathological facts; and its importance in the healing art cannot be too much dwelt upon. It will enable us to discriminate what are the idiopathic or primary, and what are the symptomatic or secondary affections of these two systems—the circulatory and respiratory. It will account for many serious errors which have crept into our systems of nosology, whilst it will ultimately lead to a rational method for the treatment of many of the diseases of the thoracic viscera.

Relation of the lungs, heart, and brain.

The foregoing remarks on the functions of the lungs apply equally to the cerebro-spinal system, which, as has been shown, is influenced by every change in the functions of the heart: so that the three vital organs—the *lungs*, the *heart*, and the *brain*—are all so intimately associated, that it is impossible that any disturbance can take place in the functions of the one, without some corresponding change in the functions of the others.

Pulmo-cardiac congestion explained;

When there is merely a temporary increase in the action of the heart, such as that caused by violent exercise, or from sudden mental excitement, a corresponding frequency will be observed to take place in respiration; and, the blood being the natural stimulus of the heart, the increased frequency of the breathing and of the beatings of the heart, which is thus produced, has the effect of reducing within the scope of the natural standard, more or less quickly, whatever blood may have been congested in the thoracic viscera.

Illustrated in animals.

These phenomena are exemplified, when a person performs any act of great muscular exertion; and in a still greater degree they may be observed in those animals remarkable for their speed, such as the *greyhound* after a long chase; the great impulse of the heart and the rapidity in breathing continue a very considerable time before the respiratory and circulating organs become tranquillized.

How *pulmo-cardiac* congestion is warded off by the economy.

But whenever the *pulmo-cardiac* congestion is such, that the increase in the frequency of the action of the heart and in respiration is not sufficient to eject the superabundant blood, and to restore the due balance of the circulation, then the breathing becomes modified by those acts of the economy, which further enable both the heart and respiratory organs still to expel the congested blood.

These acts enumerated as symptoms.

Now, the instinctive acts of the respiratory organs to which I allude—*sobbing*, *sighing*, *weeping*, *laughing*, *crying*, *coughing*, *sneezing*, *hiccup*—are likewise resorted to by the *vis medicatrix naturæ*, being efforts employed to restore those disturbances in the circulation which have been caused by disturbances of the heart.

Pulmo-cardiac congestion becomes permanent.

But these instinctive acts of the system for restoring the balance of the circulation are not sufficient to relieve the pulmonary vessels and heart of congestion, when it has advanced beyond a certain degree; hence is produced that permanent difficulty of breathing, *dyspnœa*, *asthma*, *cough*, and *hæmoptysis*—symptoms, which are so frequent in those afflicted with some disorders of the heart. Indeed the derangements of the *pulmo-cardiac* function, from the changes which they produce in respiration, and especially the cough and the hæmoptysis, often mislead; and I may confidently assert, that I have almost daily opportunities of observing such cases which have been considered *primary* affections of the lungs, but in which all the symptoms were traced to a disordered heart, and permanent relief obtained by restoring its function.

Diagnosis of *pulmo-cardiac* congestion very important.

"In those affections of the heart which come on suddenly, as after a violent effort, a blow, or a strong violent emotion, the respiration is sensibly altered, the very moment when the cause has been applied, and often the difficulty of breathing is the first symptom which announces the approaching disease."

Corvisart.

Having premised these general observations on the influence which disturbances of the heart create in the respiratory apparatus, let us examine, more at length, some of the more prominent *symptoms* which have been enumerated, and by which we shall be better enabled to appreciate their importance in the semeiology of the heart.

The particular symptoms.

TABLE OF THE SYMPTOMS DERIVED FROM THE RESPIRATORY SYSTEM.

Dyspnœa,
Asthma,
Wheezing,
Coughing,
Pulmonary hæmorrhage,
Pulmonary apoplexy,
Hiccup,
Sobbing,
Sighing,
Yawning,
Weeping,
Laughing,
Sneezing,
Crying,
Screaming.

Respiration, it may be remarked, like circulation, is constantly varying, not only in every healthy individual, but it varies also in different persons, all of whom are apparently under the same circumstances. The lungs appear to require different quantities of air for the oxygenation of the blood, just as the heart is furnished, at different times, with different quantities of the vital fluid; so that it becomes a nice point to determine the precise boundary between healthy and diseased respiration. Indeed, it is only during sleep that the frequency of the aspirations, or the action of the heart can be said to be perfectly tranquil, and only when the frequency of respiration, as well as the vigour of the circulation, are greatly diminished.

Differences observed in healthy respiration.

"The lungs are computed to contain, at the time of their utmost fulness, about 220 cubic inches of air. When we continue breathing in a natural and easy way, we draw in and expel alternately about forty cubic inches; but when we choose to force respiration, we can expel, without danger or harm, about seventy inches more: we can expel 110 inches of air, leaving only 110 inches in the lungs. There remains always in the lungs a great mass of air, and which I call the *permanent* dilatation of the lungs; so that in like manner as the heart's cavities are never completely empty of blood, the lungs always retain a certain quantity of atmospheric air."

The capacity of the lungs.

John Bell's Anatomy.

From the great variety in the number, and in the extent of the inspirations in different persons, we are led to infer, that to sustain life, very different quantities of atmospheric air are required by different individuals. This is confirmed by the extraordinary number of the *bronchi* frequently found after death completely obliterated, and also in persons, in whom the powers of life have appeared to be little diminished even towards its close.

Frequency of the aspiration.

One aspiration in a person in health takes place for every four beats of the pulse: two pulsations being made during inspiration, and the other two during expiration; so that the arterial pulse may always be a guide for determining the frequency of respiration, as well as the number of the aspirations determine the frequency of the pulse. As the ordinary pulse of an adult is calculated at about seventy beats in a minute, the average number of the aspirations will be eighteen. One physiologist, however, has calculated that the aspirations vary from twelve to fifteen; another that they may be reckoned at twenty; and another at twenty-six in a minute. This contradictory account of so common a phenomenon can only have arisen from want of due attention to the particular state of the individuals on whom the observations were made.

Differently estimated by Laennec, Bostock, and others.

As there can be no change in the functions of the heart without accompanying changes in the pulmonary circulation, a variety of conditions of the respiratory apparatus becomes manifest in disturbances of the heart: all such modifications in respiration being instinctive acts of the economy made to restore and preserve the proportion that is necessary between the quantity of air and blood which is contained within the lungs.

In affections of the heart, respiration is liable to changes in *frequency;* to changes in *rhythm;* and to changes in *intensity.*

Changes in the frequency of respiration.

In *frequency*, respiration varies in different disorders of the heart. In some affections, the number of the aspirations are very much increased, such as in the inflammatory diseases of its different tissues; whilst in another class of diseases of the heart, where the circulation is feeble, the frequency of respiration is greatly below the natural standard.

Changes in the rhythm.

The most remarkable change of respiration in disorders of the heart is, when the inspirations and expirations do not preserve their natural *proportions;* sometimes the inspirations are lengthened, and the expirations abbreviated; sometimes the inspirations, and at other times the expirations are prolonged; and sometimes the expirations are made with great difficulty.

These changes in breathing are constantly taking place by the various instinctive acts employed by the economy to preserve the balance of the circulation, and likewise in diseases. Thus, when the lungs are emphysematous, the inspirations are made easily, and the expirations are made with difficulty; whereas in tuberculated lungs, the inspirations are difficult, and the expirations more easily performed.

"In long retentions of the breath," observes Haller, "as in making violent efforts, the *venous* blood, especially of the head, stagnates before the right ventrical, which is closed up because it cannot evacuate its blood into the lungs; and, tumefying the face with redness, the blood sometimes bursts the veins of the brain, neck, intestines, kidneys, or lungs, or even the right auricle. This is the cause of excessive anxiety of mind; this is the cause of death in compressed *air*, in persons who die suddenly when evacuating the bowels, or in persons drowned or strangled, and which is much more sudden than is usually imagined with regard to drowned people.

"A living person, therefore, that he may remove those inconveniences which arise from the passage of the blood being obstructed, slackens the powers of inspiration, and excites the action of those of expiration, in order to free the breast from the too greatly rarefied air. Hence expiration is performed more easily and quickly than inspiration."

Dyspnœa and asthma.

A change in the *rhythm* of the breathing constitutes *dyspnœa* and *asthma*; the first signifying merely a lesser degree of difficulty in breathing, than the second; and, although these terms imply only the *symptoms* of a disturbed circulation, they have been considered primary diseases, and arranged by Cullen under the the class of "spasmodic affections without fever."

Changes in the intensity of respiration.

In *intensity*, respiration undergoes various changes in disorders of the heart; sometimes becoming so extremely feeble as to render the voice almost inaudible.

Case recorded by C. Bell.

A paralytic patient ceased to breathe the moment he fell asleep; so that he awoke the next instant from a sensation of suffocation. When sleep began to overpower him, respiration became slow, the pulse fell, and even the heart's action ceased.[1]

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[1] It has been said that holding in the breath violently has caused death, and that criminals have resorted to this mode of destroying themselves.

These varied changes in respiration may doubtless be also present, when there is a primary disease in the lungs; which may have caused such a disturbed action of the heart, as to produce derangement of the *pulmo-cardiac* function ; but this function cannot be deranged, without being accompanied by a corresponding change in the functions of the heart.

It is important to decide, how far the peculiar disturbances in respiration which have been alluded to are to be considered pathognomonic of a disordered heart; and though Corvisart has remarked that " the disturbances in respiration, considered isolatedly, give only equivocal signs of these affections of the heart, because in general they are common to several diseases of the chest," yet it appears to me that in all cases, where the disturbances in respiration are such as arise from a derangement of the *pulmo-cardiac* function, that such disturbances must undoubtedly be considered as pathognomonic of a disordered heart; being aware at the same time that the history of the symptoms, the character of the accompanying cough, and the anatomical symptoms, ought also to be taken into consideration, whenever we endeavour to discriminate the true nature of the disease.

Coughing.

Coughing.

No symptom more unequivocally characterizes a disturbance of the pulmonary circulation than cough ; and, as such a disturbance is often accompanied with a corresponding change in the heart's action, cough may be classed among the *symptoms* of a disordered heart, as well as among those of diseased lungs.

The two offices performed by the lungs.

When enumerating the different offices performed by the respiratory apparatus, it was stated that one of these was *coughing*, and that this was an act resorted to by the economy to effect one of two purposes,—either to restore a disturbed circulation in the lungs, or to evacuate some morbid secretions or extraneous substance from the bronchi.

Now, the characters of each of these coughs, it is essential to observe, are perfectly different. The one is dry, with convulsive movements of the chest, more or less violent, as may be necessary for restoring the pulmonary circulation ; the other is comparatively less severe, being only required for expelling some morbid secretion from the bronchi.

Imperfect arrangement of coughs.

Though pathologists have attempted to arrange coughs into two classes—the *dry* and the *moist*—yet, on examining minutely the diseases of the chest, we are struck with an apparently endless variety in the characters of the coughs by which they are accompanied: how imperfect therefore is such an arrangement.

Varieties of coughs.

Nothing can be more different from one another than the slight, short, tickling, and dry cough which accompanies tubercular disease of the lungs;—the severe paroxysm of coughing, with profuse expectoration, characteristic of inflammation of the mucous membrane of the bronchi;—the short, dull, dry cough, accompanied with local pain, of pleuritis;—the violent spasmodic cough, with sense of suffocation from some local irritation of the larynx, as an elongated uvula, inflammation of the mucous membrane of the pharynx, or upper part of the larynx;—the spasmodic paroxysms of coughing, without expectoration, which depend upon derangement of the digestive organs;—the violent spasmodic cough, with prolonged inspirations, followed by vomiting, which is peculiar to hooping-cough;—the *laryngismus stridulus* of infants;—the dry, hard, and suffocating cough, the pathognomonic symptom of croup. All these coughs differ essentially from a paroxysm of the dry cough, with more or less dyspnœa and embarrassment of breathing, which arises from a disturbance of the pulmonary circulation caused by a disordered heart.

That coughs should assume so many different characters may be readily explained by considering the respiratory organs as a simple physical apparatus; for it is quite evident that, according to the changes in the form of the air passages, and the intensity and duration of the expirations, so will the sound be varied, just as the tones of a common trumpet are changed by changes in the blast of air passing through it.

Their discrimination important.

To be able to discriminate those different coughs, and refer each to a particular condition of the pulmonary apparatus, requires the same tuition of the ear, as the sense of *touch* requires to discriminate the various changes in the arterial pulse. The cough, symptomatic of a disordered *heart*, is harsh and loud, comes in severe paroxysms, and is usually brought on by some

Character of the cough accompanying a diseased heart.

movement of the body, such as lying down, and especially on rising up in bed, by turning in bed, or by speaking more or less loud; but there is seldom cough when the body is perfectly still. There is no expectoration accompanying the cough, but there are sometimes nausea, and even vomiting towards the end of the paroxysm, and often great exhaustion from the violent action of the respiratory and abdominal muscles. Such is the violence of the expirations, that the involuntary discharge of urine during a paroxysm of coughing is not unfrequent, especially in those of a nervous temperament: this sometimes takes place to so great an extent as materially to distress the sufferer.

Influence of the cough on the pulmonary circulation.

These phenomena all confirm the explanation I have given of the cause of this particular cough; for it is quite evident that it is brought on by whatever muscular exertion excites even in the slightest degree the action of the heart; the act of coughing relieving the heart and lungs of the increased quantity of blood congested in the pulmonary vessels. Hence may be satisfactorily explained, how such coughs are diminished by avoiding whatever causes any increase of blood in the chest; and it is extremely probable that the relief which many so afflicted find from the use of *lozenges*, arises from the mouth being kept closed, thus limiting the inspirations.

The cough which arises from a disturbance in the *pulmo-cardiac* function may be combined with other diseased changes, more especially with inflammation of the mucous membrane of the bronchi; so that, whilst the characters of the cough caused by a disordered heart are all present, there will be also other symptoms present; the most striking of which is a morbid expectoration of mucus, causing the cough, in place of being dry, to become *moist*.

Pertussis.

Among those coughs which are connected with a disturbance of the functions of the heart, may be mentioned *hooping-cough;* for, whether the respiratory organs or the heart be primarily affected in this disease, the functions of both these organs are so greatly influenced, that there is always, throughout its progress, a complicated assemblage of symptoms arising from both the respiratory and circulating organs being deranged. This connexion of the respiratory organs with the heart in hooping-cough is corroborated by the effects of some of the most efficacious remedies in that disease—such as the sulphates of zinc and of alum, and hydrocyanic acid; these being known to have a specific action on the circulation.

Pulmonary Hæmorrhage.

Hæmoptysis.

A spontaneous bleeding from the capillaries of the pulmonary mucous surface is, perhaps, one of the most unequivocal symptoms of a disordered heart; and there are few cases where the circulation has been either much, or for a long time, disturbed, in which some spontaneous hæmorrhage has not occurred more or less frequently, either from the capillaries of the pulmonary, ethmodial, or portal vessels.

It becomes an important practical point to determine what are the different conditions of the heart, in which these spontaneous hæmorrhages occur, as it would show on what portion of the mucous membrane artificial blood-letting would be most beneficially employed in the treatment of particular diseases.

It is no less interesting to discriminate the *kind* of blood which is discharged in spontaneous hæmorrhages—whether it be arterial or venous—a subject which has never sufficiently engaged the attention of pathologists.

Pulmonary hæmorrhage is caused, I am convinced, far more frequently by *pulmo-cardiac congestion* than even by any idiopathic disease of the lungs; though it has usually been considered as a symptom of some primary affection of the respiratory organs. It is the more remarkable, that pulmonary hæmorrhage should have been so generally considered to be the consequence of an organic disease of the lungs, when medical records abound with examples of persons not only recovering from very profuse and repeated attacks of spitting of blood, but who were permanently relieved of a *pulmo-cardiac* congestion.

Beneficial effects of hemoptæ.

When a spontaneous hæmorrhage has taken place from the gastro-pulmonary mucous membrane, no abrasion has been detected at the place from which the blood has receded; and on examining the uterus of women who have died during menstruation, no change could be discovered in the mucous membrane of the uterus. "Such hæmorrhages must, therefore, be considered a mere exhalation from the mucous capillaries."

Bichat.

Laennec.

"However severe the affection may be, the resolution of pulmonary engorgement appears to take place with great facility, for we see many persons who have recovered after having been the subjects of repeated abundant hæmoptysis." The circumstance that pulmonary hæmorrhage is not always followed by pernicious effects on the general system, is a strong proof that such spontaneous bleedings may take place unconnected with *ulceration* of the lungs, or with any other organic change in that viscus. Portal observed, "that those who habitually spit blood are rarely phthisical."

This subject opens an inquiry of the deepest practical importance; and from the physiological doctrine of the pulmonary circulation which I have endeavoured to establish, as well as from numerous pathological facts, it will, I am persuaded, appear that, as many cases of *cough*, which have been considered to be the effects of diseased lungs, are symptomatic of a disordered heart; so in many instances pulmonary hæmorrhage may take place unconnected with any diseased structure of the lungs, but may be solely caused by a disturbance of the *pulmo-cardiac* function.

Pulmonary hæmorrhage symptomatic of a disordered heart may occur in every possible degree; in some cases the sputa being only slightly tinted with blood, and in others the quantity of blood is surprising.

Case

A lady ran violently under the influence of fear, spat up, in a few minutes afterwards, a large quantity of blood, and continued to expectorate a small quantity almost every day during the subsequent twenty years of her life. In another case, ten pints of blood were coughed up in twenty-four hours.

Laennec.

Case.

A lady, in the bloom of life, was suddenly attacked, when riding on horseback, with hæmoptysis. She spat up several pints of blood, yet she enjoyed perfect health for many years.

Premonitory symptoms of hæmoptysis.

These spontaneous hæmorrhages are not usually attended with febrile symptoms, but, when profuse, are preceded by a rigour, which, by increasing the quantity of blood in the internal organs, renders the pulmonary vessels more turgid, and by causing them to give way more easily, aids the efforts of the *vis medicatrix*.

The hæmorrhagic paroxysm is preceded by coughing, just as bleeding from the nose is by sneezing, and the hæmorrhoidal flux by tenesmus and purging.

Pulmonary Apoplexy.

Pulmonary apoplexy.

Though pulmo-cardiac congestion is sometimes relieved by a *spontaneous hæmorrhage*, the blood being exuded from the mucous capillaries of the lungs, in other cases, when the congestion takes place to a greater degree, the pulmonary vessels are ruptured, and hence arises a pulmonary *apoplexy.* In this case, the blood, in place of being exuded upon the mucous surface, is effused from the ruptured vessels into the parenchyma of the lungs, where it remains having all the characters of an *ecchymosis* in other tissues. There must, therefore, be a remarkable difference in the tissues of a lung that has been affected with *hæmoptysis*, and one with pulmonary *apoplexy;* the blood in the first case making its escape by exudation, whilst in pulmonary apoplexy the blood consolidates, and renders whatever portion of the lungs into which it has been effused unfit for the oxygenation of the blood. We must, therefore, expect to find a permanent defect in respiration in all that portion of the lung which has had its air-cells obliterated, and a corresponding change in the action of the heart. This, I suspect, is precisely the condition of those who never completely recover their natural breathing after severe *pulmo-cardiac* congestion; such as that which has been caused by some violent muscular exertion or great mental excitement. In those, where life is extinguished from *pulmo-cardiac* congestion, and in those also, who have died from hanging or drowning, blood in all these cases is found effused into the *parenchyma* of the lungs.

The Respiratory Murmur.

Changes in the respiratory murmur

Besides changes in the frequency, rhythm, and intensity of the aspirations, there are also changes in the respiratory murmur, which are caused by disturbances in the heart.

The respiratory murmur is sometimes loud, sometimes feeble, or it is altogether absent in some disorders of the heart, where the circulation has become extremely languid. Sometimes it is harsh, varying in force, hard, and dry; and sometimes it is of a hollow or cavernous character.

The morbid sounds which are so frequently heard in primary affections of the lungs, may be also combined with disturbances in the functions of the heart. There may be either a moist, though far more frequently a dry, husky sound mingled with the respiratory murmur, or the sound may be sonorous, crepitating, or gurgling. These sounds, when they accompany a disordered heart, are the effect of changes which have taken place in the lungs themselves, especially in their mucous membrane; and this tissue is more or less affected in most instances of cardiac disease, especially in those of an acute character.

Hiccup.

Singultus. Hiccup often takes place in persons who have disorders of the heart; so that, in cases of hiccup, particularly in those where it is much prolonged, it may be suspected that there exists some disturbance in the circulation.

Case. A gentleman, after recovering from the effects of a severe fit of *venous apoplexy*, and in whom the circulation of both the portal and cerebral systems was greatly disturbed, had an incessant hiccup, whilst he was awake, which continued during fourteen days.

It is by no means unfrequent to observe a paroxysm of hiccup following that disturbance in the heart subsequent to a fit of laughter. A case has already been referred to, where, after an immoderate fit of laughter, a violent hiccup came on which caused great uneasiness in the cardiac region, and which was relieved by local blood-letting.

Hiccup may also be symptomatic of affections of other organs. In some instances, it appears to be connected with a derangement in the functions of the alimentary canal: it is considered to be a fatal symptom when a portion of intestine has become strangulated. It is, also, of constant occurrence in children who are apparently in health.

Case. A man, after a debauch, was attacked with a severe and incessant hiccup, which, after having lasted some days, ceased immediately, after the contents of a large abscess were artificially discharged. It was then found "that the whole course of the external respiratory nerve was engaged in the abscess."

Note of a case by Mr. Mackenzie.

Sneezing.

Sneezing.

Sneezing is another symptom which may be sometimes observed in persons with a disordered heart. I have already made allusion to the remarkable sympathy which subsists between the heart and the *organ of smell*, and the influence of odorous substances upon the heart. The act of sneezing is employed by the system, not only for removing extraneous matters irritating the Schneiderian membrane, but also, like other instinctive acts, it is resorted to in order to restore the balance of a disturbed thoracic circulation. Hippocrates "purged the head" by creating violent paroxysms of sneezing.

Case.

A lady, who had been subject to a disturbed circulation, and who was considered to be hysterical, had a violent paroxysm of *sneezing*, which, after lasting nearly an hour, became very alarming; but on a vein in the arm being opened, she was immediately relieved.

Case.

"A lady was liable to fits of incessant sneezing, attended with an abundant flow of watery fluid from the nostrils. This sometimes alternated with a nervous cough, while not unfrequently she suffered under that sensation in the throat called *globus hystericus*."

Brodie on *Local Disorders*.

Case.

A naval officer was always attacked with a fit of violent sneezing whenever he smelt *Ipecacuanha*.

Epistaxis.

In like manner as the act of coughing produces pulmonary hæmorrhage, so we often find that a paroxysm of sneezing causes a spontaneous hæmorrhage from the Schneiderian membrane; hence in all cases of *epistaxis* it is of consequence to inquire into the condition of the thoracic viscera, as well as into that of the cerebral circulation.

Influence of other instinctive acts.

I have already pointed out certain instinctive acts which are employed by the enonomy to restore those temporary changes and derangements in the circulation of the thoracic viscera, which are constantly taking place in a healthy person during wakefulness. And as these acts are also observed in those suffering from diseases of the heart, being resorted to by the *vis medica-*

trix, in the same manner as they were employed by the *vis conservatrix naturæ*, in order to correct and ward off the evil effects of impediments to the circulation, they may be, therefore, with propriety, added to the catalogue of *symptoms* of diseases of the heart.

I have already alluded to the salutary effects of some of these instinctive acts upon a disordered heart—how, in one instance, a paroxysm of syncope, to which a lady was subject, could be prevented by her singing;—how a youth could prevent an epileptic paroxysm by repeating aloud the Lord's prayer;—and how another revived the circulation, when he found himself breathless, by vigorous breathing: all these individuals were suffering from some disease of heart.

Laughter,

Which, as I have pointed out, has so powerful an influence upon the heart, is a symptom frequently observed in those whose hearts are easily excited, especially in hysterical women.

Whilst moderate fits of laughter, such as those which accompany cheerfulness and mirth, relieve the circulation, and

> "Cleanse the foul bosom of that perilous stuff
> Which weighs upon the heart,"

Shakspere.

violent paroxysms of laughter produce pain in the cardiac region, and sometimes disturb the heart to so great a degree as to cause fatal convulsions.

Sighing, *Sobbing*, *Weeping*, *and Crying*,

Have, likewise, been shown to be instinctive acts resorted to by the economy, in order to preserve and restore the balance of the circulation in the thoracic viscera; they also frequently execute the same office when they are employed by the economy to accompany diseases of the heart.

"*Sighing* is caused by the drawing in of a greater quantity of breath to refresh the heart that laboureth, like a great draught when one is thirsty. *Sobbing* is the same thing, stronger. *Groaning*, and *screaming*, and *roaring* are caused by an appetite of expulsion, as hath been said; for, when the spirits cannot expel the thing that hurteth, in their strife to do it, by motion of consent, they expel the voice." Bacon.

Case. A young lady, who, after severe mental excitement awoke, *screaming* violently, continued for two years afterwards to suffer from a sense of fulness, and sometimes from pain in the region of the heart, a strong impulse of the heart, and a small, contracted arterial pulse, coldness of the extremities, and frequent paroxysms of *sighing*, *yawning*, and *sobbing*, but no cough or difficulty in breathing; all which symptoms yielded to the application of a few leeches to the cardiac region, and to the use of antimony and of iron.

Seneca, speaking of his own malady, observes:—"It may properly enough be denominated sighing; the attack is very short, and like a storm, it usually ends within an hour: to have any other malady is to be sick; to have this is to be dying."

The Voice and Speech.

Changes in the voice. In those disturbances of the heart which influence the respiratory organs there may be likewise observed corresponding alterations in the voice.

The formation of the voice being one of those several functions performed by the respiratory apparatus, it must happen, that not only the vocal organs are changed in primary affections of the lungs, but also in all the disorders of the heart wherein the pulmonary circulation is disturbed.

The lungs being employed to impel the air through the vocal organs, changes in the force of the current of the air impelled through them must be caused by changes in the functions of the lungs; many of which changes arise from disorders of the heart. The peculiarities in the voice denoting disturbances in the functions of the heart will therefore be found to be an order of *symptoms* of no inconsiderable value in semeiology.

To estimate the value of the *symptoms* derived from the changes in the voice in diseases of the thoracic viscera, we must carefully discriminate such changes from those remarkable peculiarities in the natural voice, which are so frequently observed in those who are in health.

The power of producing *sounds* is common to all animals that

CHAP. XVIII.

Man alone endowed with speech.

breathe with lungs; but *speech* the Creator has bountifully bestowed on man only, to enable him to communicate his thoughts to his fellow-beings. Thus, along with his other gifts, "does man stand prominent among sublunary objects, and is distinguished by remarkable endowments above all other terrestrial beings."[1]

Combe.

Speech and sounds, how they differ.

The *voice* is a distinct sound, produced by the passage of the air through the larnyx; and *speech* is produced by the movements of the parts within the mouth. Voice and speech are therefore two distinct phenomena: one taking place in the larynx, and the other resulting from the action of the parts contained in the mouth—the palate, the tongue, the teeth, and the lips. Hence, too, the great differences between those alterations in the voice which are caused by changes in the larynx, and in those which are caused by changes in the mouth.

The qualities of the voice;

The human voice varies exceedingly in its *compass;* in its *tone;* and in its *intensity* or volume; these qualities are all subject to changes in the diseases of the heart.

its compass.

Compass.—The entire scale of the human voice is usually calculated to be about thirty-two notes, or four octaves. The scale is usually divided in the two sexes; the lower octaves being appropriated to men, the higher octaves to women. This, however, is not always the case; some men possess high notes in the upper part of the musical scale, and some women very low notes.

Alterations in the voice are remarkable, both in speech and in singing.

When the lungs cannot expel a sufficient quantity of air with sufficient force through the larynx, not only is speech abbreviated, but the higher notes of the voice become more or less imperfect; so that in speaking, there is generally an alteration in the musical key on which the voice is pitched; and a person who in health is able to sing is more or less incapacitated from doing so, when the thoracic circulation is much disturbed.

The vocal organs being constructed both as a wind and a stringed instrument, imperfections in the voice may arise either from changes in the aperture of the glottis, or in the vibrations of its elastic materials; and as the vibrations of the larynx depend on the force of the current of air passing through it, the changes in the aperture of the glottis will increase or diminish the force of the current of air, and, like the lips of the musician, vary the character of the sound.

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[1] It has been affirmed that the *hyæna* could imitate the human voice; that it remembered the names of the shepherds, called to them, charmed them, rendered them motionless; that, at the same time, it gave chase to the shepherdesses, caused them to forget their flocks, to be distracted with love, &c. All these things might surely happen without the intervention of a hyæna.—BUFFON.

Changes in the compass of the voice can be easily tested by the patient accompanying each note with a musical instrument. He will find his incapacity to sing certain notes which he was able to do when in health: he can thus accurately ascertain the notes in his voice which he has lost. In the same manner, any amendment in the voice can be measured.

Changes in its tone.

Tone.—The difference in the tone of the voice is various. It varies exceedingly in disorders of the heart, and the changes in it are readily perceptible to a musical ear. Sometimes the voice becomes more or less harsh, rough, and unmusical. There is often considerable uneasiness and difficulty in producing articulate sounds.

Case.

A youth suffered from *pulmo-cardiac* congestion, caused by *asphyxia.* He was long afterwards subject to a disordered heart, and on many occasions he lost his voice for a few minutes.

The tone of the voice varies much in different people; and there is often as much character in the voices of the branches of the same family, as in any other part of their organization.

The tone as well as the compass of the voice, too, is variously modified according to the difference of sex and of age; the variety of the tone is the chief cause of the different *qualities* of the voice in different individuals, in the same manner as the qualities of musical instruments differ, when the same note is sounded on two of them—as on two violins.

The musical key, on which the voice is pitched, varies; the same note being, in some persons, an octave higher than in others. Hence there are those who have a deep-toned voice—the "bass" and the "tenor," and those whose voices are high-toned—the "soprano" and the "contralto."

As the qualities of the voice depend on the structure of the vocal organs, the endless variety in the voices of singers must arise from peculiarities in the cartilages and muscles of the larynx.

In those who are suffering from diseased lungs, no symptom is more remarkable than a change in the quality of the voice; the tone becoming less and less audible, and the musical scale diminishing, in proportion as the inspiration is limited, and less air is expired from the lungs.

All these differences in the tones of the voice are important to be noticed, that we may be enabled to discriminate them from those changes which are caused by disease. So very remarkable, indeed, are some voices, that a want of due attention to the peculiarities of the natural voice may lead to an erroneous diagnosis in the diseases of the chest.

Changes in its intensity.

Intensity.—The intensity or volume of the voice is considerably altered by those changes in the respiratory functions, which depend upon the condition of the heart. As every alteration in the volume of the column of air expelled through the larynx during expiration must produce a change in the voice in all those diseases of the heart in which the pulmonary circulation is influenced, the voice will be more or less changed; at the same time, it is of importance to observe, that changes either in the larynx, in the tracheal tube, as well as in the lungs, must, by altering the volume and force of the current of air, passing through the vocal organs, alter also the intensity and the tones of the voice.

There is frequently a singular peculiarity in the musical key, in which the voice is pitched. In some persons it is pitched an octave higher than in others, even in common conversation. This is particularly the case in speaking different national languages, of which we have examples in the races in the British empire.

The voice is sometimes temporarily destroyed, either from loss of power in the vocal organs, or of those of the articulate sounds.

The differences in the compass, in the tone, and in the intensity of the voice are remarkable in the two sexes. Woman's voice is most commonly pitched in a much higher key than that of man. Hence the "soprano" and the "contralto" are fitted for her song; whilst the "tenor," the "baritone," and the "basso," are suitable to man.

It is not, however, very uncommon for a woman's voice to resemble a man's, both in tone and pitch; neither is it rare for a man's voice to resemble that of a woman.

At the age of puberty there is a well-known change in the voice of both sexes—to use a common expression, the voice is then "broken." In some instances, however, this change never takes place, in consequence of imperfect organization, of which there is a remarkable example in the *falsetto* of the eunuch's voice.

Conclusion

In concluding these remarks, I may observe that much useful information may be often obtained, in all the diseases of the thoracic viscera, by attending to the character of the vocal organs. As the compass, the tone, and the intensity of the voice depend on the integrity of the lungs, and as every disturbance in the action of the heart is accompanied by a corresponding change in the pulmonary circulation, the lungs must participate in every change of the circulation in the heart; and, consequently, the character of the voice will be variously modified. The voice is also altered in almost every primary disease of the lungs; for, whenever the structure of a portion of lung becomes diseased, either by the obliteration of its air-cells, or by the formation of a "cavern," the voice is completely changed.

CHAPTER XIX.

SYMPTOMS OF DISEASES OF THE HEART DERIVED FROM THE VASCULAR SYSTEM.

Symptoms derived from the arterial system; importance of a knowledge of the arterial pulse; the arterial pulse an essential guide in pointing out the condition of the left heart; functions of the arteries liable to changes independent of the heart; the arterial pulse varies in frequency, regularity, and vigour; table of the different pulses; the arterial and cardiac pulse do not always correspond; symptoms derived from the venous system; these symptoms characteristic of diseases of the right heart; congestion of the subcutaneous veins; congestion of the cerebral and portal systems; the venous pulse; œdema; symptoms derived from the capillary system; changes in the cutaneous surface; redness, paleness, lividity, heat, coldness, shivering, hæmorrhage from the gastro-pulmonary mucous surface.

The arterial pulse.

As the flow of the blood in the arteries depends chiefly on the action of the heart, the functions of the arteries must undergo alterations in accordance with changes in the heart's functions; and such varied conditions of the arterial system afford unequivocal *symptoms* of the heart's diseases.

The arterial pulse has indeed been, since a very early period of the history of medicine, considered as an index of the state of the heart. "The pulse is the measure of the powers exerted by the heart, because it is the immediate and full effect of these powers. Hence, all things alike, the pulse is slow in the state of perfect health, when there is no stimulus, no resistance acting as a stimulus, and the heart propels the blood freely and easily, except where there is some obstacle by which the blood is prevented from entering the aorta."

Haller.

Importance of a knowledge of the pulse.

As changes in the arterial pulse denote corresponding alterations in the heart's movements, and afford numerous and important diagnostic signs in its diseases, an intimate acquaintance with these changes, along with a knowledge of those which take place in the nervous and respiratory organs, are, it will be found, more indispensable for establishing a correct diagnosis in diseases of the heart than a knowledge of the impulse and sounds of the heart itself. Besides, the facility with which the arterial pulse can be examined renders the changes which it presents in diseases of the heart most important. We have not the opportunity of examining the cardiac, so rigidly and accurately, as the arterial pulse, especially the pulsation of those arteries which are adjacent to a bone, such as the radial or temporal, and therefore less, or at least less apparent changes in the circulation are readily recognised by examining the radial pulse, which cannot be recognised by examining the beatings of the heart.

Until Laennec pointed out the changes to which the sounds of the heart are liable, we had no other means of ascertaining the alterations in its functions, than by observing the arterial pulse; as also the effects which the changes in the circulation cause on the other systems, more especially on the nervous, respiratory, and digestive systems. Limited as the means of diagnosis might have been, yet I am persuaded that fewer and less serious mistakes were then committed than are now made by those who look chiefly to the physical signs of the diseases of the thoracic viscera, and disregard that general assemblage of symptoms which accompany those affections, and which arise from the disturbance of other organs or from other systems of the economy.

The pulse indicates changes in the left heart only.

When pointing out these alterations in the arterial pulse, which are characteristic of changes in the central organ of the circulation, pathological inquirers speak of the heart in general, and not of any of its particular portions. But it is quite evident that, as the arterial pulse is a measure of the currents of the blood in the *left* heart, that alterations in the pulse must arise from, and be characteristic of, those alterations in the blood's currents which are produced by changes in the systemic heart. "The examination of the radial pulse is far from being able to give an idea of the general circulation, and cannot even give a knowledge of the circulation in the heart; for the pulse corresponds only with the *left* ventricle, and this may be regular when those of the auricles or right ventricle are not so." Laennec.

Hence arises a distinct and important line of demarcation between the diseases of the pulmonic, and those of the systemic hearts; the changes in the arterial pulse in each being of a very different character.

Whilst the opinions of physiologists remain so unsettled as to the causes of the *sounds* of the heart,—the mode by which the blood is propelled through the arterial canals, and the functions which even the coats of the arteries perform, it cannot be expected, that the various alterations in the functions of the arteries, as indicated by the pulse, could be very satisfactorily explained.

It is, however, essential to observe the various changes which take place in the arterial pulse in the different diseases of the heart, and to discover as far as possible the alterations in its structure and functions with which those changes correspond.

Pulse altered from various causes.

Observation has shown that the pulse is altered both in organic and functional diseases of the heart, and that certain states of the pulse not only accompany particular diseases, but also indicate the use of particular remedies. We can chiefly discriminate by the pulse the diseases which require an antiphlogistic treatment, from those in which an opposite system is necessary. In the first instance, the irritable state of the heart's parietes may cause an increase in its impulse which is tranquillized by diminishing the quantity of the stimulating blood. In the latter case, the pulse may be rendered more frequent by a debilitated state of the body;—the left ventricle, not being so capable of emptying itself, sooner dilates and consequently is sooner stimulated by the blood to contract, so that a greater number of contractions are requisite to propel a sufficient quantity of blood throughout the system.

We further know that all impediments to the circulation influence and modify the arterial pulse. If the blood's stream be interrupted in the aorta, or in passing from the right auricle into the right ventricle, or if there be any impediment to the pulmonary circulation, either from disease in the vessels of the lungs, or from a change in the structure of a portion of the lungs, under any of these circumstances, there are alterations in the pulse, some of which are so remarkable as to be sufficiently characteristic of particular diseases of the heart.

Alterations in the pulse very numerous.

On comparing the number of sensible changes in the arterial pulse with the number of the diseased sounds of the heart, we are struck with the far greater number in the changes of the pulse; so that if both the alterations in the heart's impulse and sounds, and the changes in the pulse assist materially in establishing the diagnosis of diseases of the circulation, and serve as indications for their treatment, those of the arterial pulse certainly afford the most abundant signs.

Pulse not altered in all affections of the heart.

It is of consequence, however, in considering this subject to recollect what has been already mentioned—that diseases of the heart may sometimes exist without any apparent change in the arterial pulse, though the arterial pulse is seldom changed without a corresponding deviation in the action of the heart. Thus, when the heart's action is violently increased, which takes place in the *thoracic aneurism*, the great increase in the impulse which the heart acquires, does not affect the arterial pulse, but is lost, or, as it were, destroyed, in overcoming the resistance which the aneurism causes to the circulation. It may be stated, as a general observation, that in cardiac congestion, and in all cases where the heart's impulse is increased, in order to overcome an obstruction to the circulation, the increased impulse will not necessarily affect the arterial pulse.

This apparent discrepancy in the actions of the heart, and the indications afforded by the arterial pulse, are remarkable when the aortic valves are diseased, or when the calibre of that artery is diminished; for though the heart is compelled to act with an increased vigour to overcome such obstructions to the free transit of the blood, yet the force of the arterial pulse is diminished. I shall afterwards have occasion more fully to explain how in some diseases of the heart, particularly when there is a preternatural quantity of blood or congestion of its cavities, the pulse is by no means a safe guide for the employment of blood-letting. Indeed, the difference in the cardiac and arterial pulses is often very remarkable.

In order to show how extensive are the variations of the arterial pulse, and with what nicety they have been discriminated, I have drawn up a table of such varieties as have been defined and characterized by distinct terms. At the same time it may be observed that in several instances the terms are nearly synonymous.

TABLE.

TERMS BY WHICH THE VARIETIES OF THE ARTERIAL PULSE HAVE BEEN DESIGNATED.

Full,
Voluminous,
Strong,
Incompressible,
Wiry,
Hard,
Tense,
Thready,
Contracted,
Firm,
Oppressed,
Small,
Elastic,
Bounding,
Sharp,
Fluttering,
Thrilling,
Quivering,
Vibratory,
Jerking,
Undulatory,
Unequal,
Irregular,
Intermitting,
Frequent,
Rapid,
Quick,
Accelerated,
Slow,
Feeble,
Soft,
Weak,
Faltering,
Languid,
Compressible.

By bringing together these various denominations of the arterial pulse, the importance of distinguishing them from one another will be the more apparent, whilst it will also show how difficult it is, and what extended observation it must require, to be able to recognise all these variations, and draw the practical as well as pathological conclusions that each may warrant. It is just as difficult to discriminate by the sense of touch all those nicer shades of difference in the arterial pulse, as for the eye, the ear, or the tongue, to perceive slight differences in the qualities of bodies which are discernible by these several senses.

Indeed, both experience and habits of accurate observation are requisite to enable us to detect the more minute changes to which the arterial pulse is liable, and to refer each to particular conditions of the circulation; this will account in some measure for the contradictory descriptions which have been given of the arterial pulse in the same diseases by different authors.

We should likewise be aware, that observations on the arterial pulse, however accurate, serve comparatively little purpose in the diagnosis, and in the treatment of diseases of the heart, unless when they are viewed conjointly with those changes in the other systems of the economy which usually accompany these affections.

Some functions of arteries are unchanged by disorders of the heart.

It is also of importance to keep in mind, when investigating this branch of semeiology, that there are some functions of the arterial system which either may or may not be influenced by a disordered heart—functions which are performed alone by the arteries.

When speaking of the functions of the arterial system, it was remarked that, after the blood is impelled from the left heart into the arteries, these vessels are employed, not merely as simple tubes for conveying the blood to the different organs of the body, but, by virtue of peculiarities in their arrangement, the circulation in them undergoes almost endless modifications before the blood reaches its destinations. It may, indeed, be said that every organ—nay, every subdivision or lobe of which an organ is composed—has its own special circulation, and the circulation in every organ is changed during every muscular movement.

These modifications are, as I have explained, effected by differences in the *length* of the arterial trunks—by differences in the *calibre* of the *branches*, compared with the trunks from which they arise—by differences in the *angle* at which they arise from the trunk—by differences in their *course*, whether *straight* or *tortuous*—by their *anastomosis* and *plexus*—by differences in their modes of *ramifying* in the various organs, and likewise by *vital* causes. It is only by the influence of the nervous system, that we can explain the sudden derivation of blood from the brain to the stomach by the presence of food; the repletion of the erectile tissues from venereal excitement; the flushing of the face from mental emotions.

Functions of the arteries alone affected.

The powers which arteries possess, independently of the heart, are also exemplified in disease. What can be more striking, than the increase in the size and apparent vigour in the temporal artery of a person suffering from a common "bilious" headache, and in whom there is not the least disturbance in the general circulation;—in the remarkable pulsation in the abdominal aorta, when there is no diseased structure in the coats of the artery;—in the increased action of the arteries contiguous to an inflamed part, as in the digital arteries, when a finger is affected with whitlow;—and in the still more remarkable functions, which the collateral branches of an artery perform whenever the transit of the blood through the trunk of the vessel has been prevented by a ligature?

Baillie.

From all these phenomena, it cannot be doubted, that the arteries possess powers and perform functions which are not depending on the heart; and, consequently, that changes will take place in the arterial pulse, which do not indicate and which are not accompanied by corresponding alterations in the functions of the left heart.

Changes take place in the heart alone.

On the other hand, changes may take place in the heart's functions, which are not accompanied by changes in the action of the arteries. If there be an excited heart, without any alteration in its structure, the arterial pulse will participate in its increased movements; but when the heart's action is increased, and if, at the same time, there be a change of its structure, then the arterial pulse will be diminished in force; for the action of the heart is, in such a case, increased in order to overcome some mechanical obstruction to the expulsion of the blood; and in proportion as the obstruction is great, so will the heart's action be vigorous, and the pulse will be in the same proportion feeble. It would be just as probable that a person who, by making a violent effort to evacuate the bladder, when there was an obstruction in the urethra, would be able to expel its contents with a proportionably increased force; instead of which, in consequence of the violence of the effort, caused by the obstruction which is to be overcome, the stream of the urine will be the more feeble.

"There are a great number of cases where the heart is severely affected, and where there is little change in the pulse. This almost constantly occurs where the right heart is alone affected, and also frequently when there is disease of the left heart. Hence the general principle, that, though the arterial pulse presents its natural characters, it must not be concluded that the heart is exempt from disease."

Andral.

Importance of distinguishing differences in the arterial pulse.

Experienced men are more or less familiar with the numerous varieties in the arterial pulse, and, without being able satisfactorily to explain the pathological condition of the circulating apparatus in the varied changes of the pulse, they nevertheless have, along with the symptoms derived from the other systems of the economy, generally found the arterial pulse to be a safe guide for regulating the treatment of disease.

The power of discriminating the minute changes in the arterial pulse has been, however, disputed by some eminent pathologists. Speaking of William Hunter, John Hunter remarks that, "though he was extremely accurate in most things, he could never feel that nice distinction in the pulse that many others did, and he suspected that no such nicety of discriminating them can really be found. I think I have been certain of the pulse having a disagreeable jar in it when others could not perceive it—when they were only sensible of its frequency and strength." This observation is strictly true; for a lengthened tuition is required to enable all persons to discriminate the varieties of the arterial pulse, and, as it is with the other senses, those of sight and touch are possessed in various degrees of acuteness by different individuals.[1]

The varieties of the arterial pulse must be the effect either of differences in the vigour of the heart—of changes in the structure of some of its component parts—of changes in its functions—of differences in the quantity of the blood contained within its cavities—of changes in the qualities of the blood—or of vital causes.

These different changes produce alterations in the *frequency*, in the *force*, and in the *regularity* of the pulse.

Changes in the frequency of the arterial pulse;

In its *frequency*, the arterial pulse is liable to great alterations in disorders of the heart.

The presence of food in the stomach, the slightest bodily exertion or mental excitement, accelerate the arterial pulse; and in some diseases its frequency is much increased, particularly in maladies of an inflammatory character, such as those of the lining membrane of the heart.

There is also a great increase in the frequency, as well as changes in other qualities of the arterial pulse, from the loss of blood, whether abstracted artificially or by a spontaneous hæmorrhage. So much, indeed, are the beatings of the arterial pulse sometimes increased in frequency, when the heart is diseased, that it is found impossible to count them accurately, and, notwithstanding the assertions of some, it is seldom that more than 150 pulsations in a minute can be discriminated.

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[1] "A physician soon arrived, who, without asking any questions about the symptoms or origin of the complaint, with great solemnity felt the pulse of the left arm of his patient, by applying gently his four fingers to it; then raising one of them, he continued to press with the other three, afterwards with two, and, at last, with only one; moving his hands, for several minutes, backwards and forwards along the wrist, as if upon the keys of a harpsichord, as far below the elbow as the pulse could be distinguished. He remained the whole time silent, with eyes fixed, but not upon the patient, and acting as if he considered every distinct disease to be attended with a pulsation of the artery peculiar to itself, and distinguishable by an attentive practitioner."—Macartney's *Embassy to China*.

its frequency diminished.

In other diseases of the heart, especially in those of a chronic nature, the frequency of the beats of the arterial pulse is very much diminished. We are told of persons in whom the arterial pulse did not exceed sixteen, and even ten beats in a minute; but in such instances it is probable that all the pulsations of the heart were not sufficiently strong to be recognised in the arterial pulse.

Case recorded by Dr. Gould of Boston.

A workman drank some cold water when overheated; the effect on the circulation was to render the arterial pulse feeble, and reduce the pulsations to thirty-five in a minute; but on relieving the congested heart by blood-letting the natural action of the heart and arteries was restored.

Case recorded by Dr. Mason Good.

In another case, a person, who had a diseased heart which was occasioned by a fit of *asphyxia*, brought on by breathing the impure air from the bursting of a gas-pipe, the pulse never exceeded thirty beats in a minute.

Case recorded by Morgagni.

In an old man who had been attacked with epileptic paroxysms, "I found such a variety of pulse that within the sixtieth part of an hour the pulsations were only twenty-two—that is to say, they were in number about two-thirds less than they ought to be; and this had been so for many months."

Case mentioned by Sir A. Cooper.

"As Lord Liverpool was walking up Downing Street, he felt an oppression upon his breath, and his pulse, which had been seventy-five in the morning, fell to thirty-eight in the afternoon. It varied from thirty-eight to forty-four ever afterwards, and he died of apoplexy in six years."

Changes in the force of the pulse.

In its *force*, the alterations of the arterial pulse in disorders of the heart are numerous.

The *strong* and the *feeble*, the *full* and the *soft*, are qualities of the arterial pulse, which are commensurate with the vigour of the heart. Such conditions of the heart will always be characteristic of the state of the body generally, indicating its weakness or its strength.

The *incompressible* and the *compressible* pulse denote either a vigorous or a comparatively feeble state of the heart; the incompressible, wiry, or thready pulse being characteristic of some active inflammatory action; whereas the compressible, soft pulse is the character of a natural state of the circulation.

The *hard*, the *firm*, the *tense*, the *wiry*, and the *thready*, the *contracted* and the *oppressed*, are all terms in common use to signify particular qualities and minute shades of difference in the pulse.

A *wiry*, a *vibratory*, and a *thrilling* pulse have been supposed by John Hunter and Fordyce to depend upon the state of the *arteries*, and not upon that of the *heart*, or on the quantity of blood circulating through the arteries.

"A *hard* pulse," observes Haller, "denotes some obstacle or stimulus, or increased action of the heart, with a greater thickness of blood, or a greater rigidity or obstruction of the artery. A *full* pulse is caused by the fulness of the artery, joined with a strong force of the heart; and a *small* pulse by the emptiness of the artery and a smaller wave of blood sent from the heart."

A *quick* and a *frequent* pulse are not synonymous terms, when applied to the pulse; for, whilst frequency implies merely the increased number of the beats without signifying the quality of them, by quickness is meant a peculiar quality of the beats. The frequency of the pulse, and also a corresponding increase in the velocity of the arterial stream, may take place by an increase in the vigour of the heart. A quick arterial pulse arises from the heart being unable to propel the blood with its proper force and in its proper quantity; and as only a small quantity of blood is then sent into the arteries by each ventricular contraction, the number of beats thus becomes increased.

There are other varieties of the arterial pulse, all of which depend upon a diminution in the vigour of the heart's action. Of this description are the *quick* and the *rapid*, the *elastic*, the *bounding*, the *vibratory*, the *fluttering*, the *slow* and the *languid*, the *jerking*, and the *undulatory* pulse.

The effects of a spontaneous hæmorrhage, or of a profuse blood-letting upon the arterial pulse, not only increase its frequency, but they also cause in it a vibratory or undulating sensation; and the depressing passions, by producing congestion of the heart, are followed by a great diminution in the force, as well as in the frequency of the arterial pulse.

Changes in its rhythm.

The arterial pulse may become *irregular* either from a disease in the structure of the heart, or from a disturbance of its functions; and there is no more common sign of a disordered heart than an irregular or *intermitting* pulse.

The radial pulse is generally examined from its representing the number of the heart's contractions; but when the heart acts very feebly, each of its pulsations may not reach the radial artery, or, when the heart's contractions are unequal in force, some may be propagated to the wrist, and others may not be recognisable in it—thus causing the pulse to intermit.

Abernethy, who ultimately perished from a disease in his heart, which commenced in early life, in narrating his own case observed—"When I lay down in bed of a night my heart intermitted to such an extent that I thought it never would beat again; then it would go on with the utmost vehemence for a time; but as the anxiety of my mind subsided, so this state went off."

Abernethy's Lectures.

There is an irregularity of the pulse in which a great variation in its frequency takes place at different times of the same day. "In one patient, who had much dyspnœa with delirium, the pulse beat only thirty times in a minute, and, some time after, sixty times. In other instances the pulse varied exceedingly on different days, and without any evident cause."

Andral

Irregularities of the pulse from medicines.

These differences in the daily beats of the pulse ought to be taken into consideration, when we are watching the effects of certain medicines, especially of *digitalis*, as effects have been often attributed to that medicine in lowering or quickening the pulse which do not belong to it.

The arterial pulse has been sometimes observed to be irregular or intermittent during health, and to become regular during acute disease, returning to its former condition during convalescence.

Some peculiarities of the arterial pulse.

Besides changes in its frequency, vigour, and regularity, there are other peculiarities of the arterial pulse which merit consideration.

See page 206.

It has been already remarked that the cardiac and arterial pulse do not always correspond in strength in some of the diseases of the heart. Changes may take place in the action of the heart which are not accompanied by any change in the arterial pulse. If there be an excited heart, without any alteration in its structure, the arterial pulse may participate in its increased movements; but when, besides the increased action of the heart, there is an alteration of its structure, then the vigour of the arterial pulse will be diminished; for, as an increased action of the heart is required to overcome some mechanical resistance to the exit of the blood from the heart, it follows that in proportion as the obstruction is great, so will the heart's action be increased, and thus the arterial pulse will become proportionably feeble.

From the foregoing remarks it may be inferred, that when the action of the heart is increased, and there is a corresponding increase in the arterial pulse, the heart's structure will be probably sound; but, on the other hand, if the action of the heart is increased, and there is no corresponding increase in the arterial pulse, but rather a diminution in its vigour, then it is equally probable that there will be some change in the heart's structure.

It sometimes, though rarely, happens that the arterial pulse is much less frequent than the pulse of the heart. Andral has mentioned a case in which "for thirty or forty beats of the artery, there were one hundred and twenty of the heart;" and a remarkable instance is recorded by Reil, in which "the heart and the carotid and radial arteries all pulsated differently." Cases.

Case recorded by Morgagni.

"In a young man who fell from a tree and bruised his back, and who suffered from a continued palpitation of the heart for nine years, I found the pulse in both the wrists unequal and irregular, yet in such a manner that it was manifest, when I attended to the greater part of the pulsations, that in the left wrist they could neither be called rare nor frequent, and that in the right they were almost three times more rare than in the left."

In some affections of the heart there is a remarkable *inequality* in the beats of the pulse. "A vibration or tensity of the pulse was, soon after, joined, and so great a celerity that, although both motions of the artery—that is, outwards and inwards—did not take up, when taken together, much more time than they generally do when in a natural state, yet the first was three times shorter than the second." Morgagni.

The pulse differs in the two arms.

It sometimes happens that the radial pulse is different in the two arms.

Corvisart.

"One of the most remarkable characters which the pulse presents in diseases of the heart is, that it is different in the two arms—or is perceptible in the one, and not to be recognised in the other arm."

Cases.

In a lady of an arthritic diathesis, and whose heart was irritable, I found the pulse in one arm had disappeared, but in six months it was again perceptible. Parry observed three cases of this kind.

Bordeau and others.

Though the observations which have been now made on the arterial pulse relate to the varied conditions of the central organ itself, and are intended to point out the changes in the heart's functions as a simple machine or forcing-pump, yet I may also allude to the differences in the pulse observed in diseases of different organs, of which much has been said by the elder writers; differences which arise from the relation and sympathy subsisting between the various organs of the economy. Although such diagnosis, derived from the pulse, may have been unwarrantably extended, yet it is universally admitted that in some diseases, as enteritis, rheumatism, and carditis, the character of the pulse in each of these organs, when inflamed, is perfectly different.

Before concluding these observations on the arterial pulse, it is necessary to bear in mind, when examining the condition of the circulation, the natural differences of the pulse of persons at different periods of life, at different times of the day, at different seasons of the year, and in the different states of the atmosphere.

Differences in the pulse, in different positions of the body;

The changes in the pulse caused by alterations in the posture of the body ought likewise to be noticed. The pulse of a healthy person, which beats sixty times in a minute, when he is in a horizontal posture, will generally beat sixty-eight or seventy times in a minute when he is in the erect posture. This difference appears to be satisfactorily accounted for by the heart being able to impel the blood throughout the system with much less force in the horizontal position of the body, than when it has to overcome the weight of the superincumbent column of the blood when the body is erect.

and from medicinal bodies.

The influence of medicinal substances upon the arterial pulse must never be lost sight of, and must always be taken into consideration in the examination of diseases. Thus neurotics have the effect of altering the pulse; and hence *digitalis*, *belladonna*, *hyoscyamus*, *opium*, *prussic acid*, and the plants containing it, are all made use of in the treatment of diseases of the circulation, from their influence upon the action of the heart.

The changes which take place in the pulse in many diseases of all organs, prove how great is their sympathy with the heart, and how disorders of the heart cause in their turn various derangements throughout the system. Thus it is that the arterial pulse is not only examined in order to inform us of the condition of the heart, but the condition of the heart informs us of the state of the organ where the primary disease exists. When, therefore, a person suffering from a local inflammation or injury has the arterial pulse changed, we do not always direct remedies to the heart, but to the affected part, by alleviating which the heart is tranquillized.

Symptoms of Diseases of the Heart derived from the Venous System.

As in diseases of the left heart, the arterial circulation undergoes certain changes, so we find that the *venous* circulation is changed in diseases of the *right* heart: these changes in the venous system afford *symptoms*, which are as characteristic of disturbances of the pulmonic heart, as those of the arterial system are of disorders of the systemic heart.

I have already endeavoured to show that, when the cavities of the heart and the pulmonary vessels become gorged with blood, the subcutaneous veins, and also those of the internal viscera, then receive such superabundant blood as the heart and pulmonary vessels cannot admit, and they retain it in their turn until the balance of the thoracic circulation is restored. Hence, we may anticipate that when the *right* heart becomes permanently congested, as often takes place in diseases, there will be a corresponding congestion in some portion of the *venous system*.

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Venous congestion may be more or less general in diseases of the heart, either extending throughout the whole of the *subcutaneous* veins, or confined chiefly to the veins of the *cerebro-spinal*, *respiratory*, or *portal* systems.

Venous congestion of the cerebro-spinal system.

In the *cerebro-spinal* system venous congestion produces those remarkable changes, which have been already mentioned when discussing those symptoms in disorders of the heart which are derived from disturbances in that system. The languor and aberration of the intellectual powers, and the diminished vigour of the organs of active motion, are all remarkable symptoms, which are caused by venous congestion in the cerebro-spinal system.

Congestion of the respiratory system.

Congestion of the right heart produces effects upon the *respiratory organs* no less remarkable. Cough, dyspnœa, and asthma, are the necessary consequences of veno-pulmonary congestion. The cough is dry and hard, comes on in paroxysms, which endure for a longer or shorter period, and terminates in profuse perspiration, nausea, and sometimes vomiting. The embarrassment in breathing is constant, though greatly aggravated by any muscular exertion—by an over-distended stomach—or by the *primæ viæ* being deranged.

"In the diseases of the heart the difficulty in breathing may arise from mechanical pressure upon the lungs, from an increase in the bulk of the heart, or from the growth of an aneurismal tumour; that is true in some cases, *but in the greater number, it appears that the difficulty in respiration is caused solely by the accumulation of blood in the vascular system of the lungs, in consequence of the impediment which it meets with in entering into the cavities of the heart, the structure of which has been changed.*"

Corvisart.

Congestion of the portal system.

The effects of a congested state of the right heart are equally apparent on the *portal* system; and hence arise an assemblage of *symptoms* in the heart's diseases, which are caused by disorders of the chylopoietic viscera.

As, in consequence of congestion of the right heart, the blood of the inferior cava vein must meet with a difficulty in flowing into the right auricle, the functions and even the structure of the *liver* undergo particular alterations by such changes in the circulation.

"In almost every disease of the heart," observes Corvisart, "the liver becomes the seat of an engorgement of blood, which I have often observed in the dead body, and which gives to this viscus, especially in the advanced stage of these diseases, an unnatural bulk. Indeed, it is easy to feel this tumefaction through the abdominal parietes; it sometimes becomes so considerable that the margin of the liver passes considerably beyond the edge of the ribs, whilst its convexity, pressing the diaphragm and mounting up the right cavity of the thorax, prevents the inferior region resounding by percussion." Corvisart, page 443.

Congestion of the subcutaneous veins. In the *subcutaneous veins* a congested state of the right heart causes manifest changes, especially in the veins of the head, face, and neck. These vessels become more or less varicose, and their smaller branches so distended as to give the skin a livid colour; sometimes so intense as to amount to a deep blue. This appearance of the veins along with more or less *œdema,* with which it is accompanied, may be therefore considered as a symptom pathognomonic of some affection of the right heart.

The *morbus cœruleus.* The livid colour of the skin, however, which is produced by venous congestion, differs materially from the blue appearance of the integuments, which is caused by an admixture of the arterial and venous blood in the heart. In the first case, the livid colour arises from an absolute increase in the number and bulk of the cutaneous veins, whereas the blue colour produced from an admixture of venous with arterial blood, is not accompanied with any increase in the number or size either of the venous, arterial, or capillary systems.

Besides, the blue colour from venous congestion does not appear over the whole cutaneous surface, but only in particular parts; whereas in the "blue disease" of the ancients the whole skin is discoloured, the mass of blood having acquired a new colour from an admixture of the arterial and venous blood.

The venous pulse. The *venous pulse* is also a symptom of a disordered heart; for when the escape of the venous blood from the right ventricle into the pulmonary artery is impeded, its regurgitation into the auricle, and from the auricle into the cavæ veins, is increased; hence arises the pulsation, which is often so remarkable, in the jugular veins.

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Symptoms of diseases of the heart derived from the Capillary System.

As it has been already observed, that disturbances in the functions of the capillary system produce changes in the action of the heart, so we find that in affections of the heart, the functions of the capillaries are more or less disturbed—disturbances which constitute an important class of *symptoms* in the heart's diseases.

But that the capillary circulation is independent of the general circulation, we have abundant proofs in the temporary flushes of the cheeks, and in the redness of particular portions of the skin. If a finger be inflamed, the diseased action appears to be at first limited to the cutaneous capillaries; and it is only when the inflammation has arrived at a certain degree of intensity that the arterial system, and subsequently the heart itself, become influenced. Hence the radial pulse may beat a hundred times in a minute, whilst the pulsations of the heart do not exceed seventy.

But the functions of the capillaries are greatly modified by the condition of the heart, and the action of the heart is equally modified by the capillaries. So intimately associated are these two portions of the sanguineous system, that, whether in acute or in chronic disease, it is seldom found that there is any serious disturbance in the one without a corresponding change in the other.

In fact, the two portions of the sanguineous system—the heart and the capillaries—are so intimately associated in all their functions, that it is seldom observed, either in acute or in chronic diseases, that there is any serious disorder of the one without some corresponding disorder in the functions of the other.

"The *general* circulation is not always so much changed in diseases of the heart as the *capillary* circulation." Laennec.

This influence which the capillaries have upon the heart, and which the heart in its turn has upon the capillaries, is exemplified by many pathological phenomena, which are observed chiefly in the diseases of the cutaneous and gastro-pulmonary mucous system.

Changes in the cutaneous capillaries.

The most remarkable of the symptoms in disorders of the heart, which are derived from changes in the functions of the *cutaneous* capillaries, are paleness and flushing, coldness and heat, dryness and moisture of the skin; some of which phenomena appear to appertain chiefly to the arterial, and others to the venous system—the one being caused by disturbances of the systemic, and the other by disorders of the pulmonic heart.

Sometimes, as when the action of the heart is increased during mental excitement, the capillaries are overloaded with blood, the skin becomes redder and warmer than natural; and sometimes, as in congestion of the heart from grief, the skin becomes pale and cold, accompanied by shiverings.

> "He withers at his heart, and looks as wan
> As the pale spectre of a murdered man!"
>
> Dryden.

Sometimes there is a dry, arid, and parched state of the cutaneous surface, and sometimes there are warm or cold perspirations.

In no disease is this influence of the heart more distinctly shown on the cutaneous capillaries than in a *febrile* paroxysm, by its cold, hot, and sweating stages; its influence also on the capillaries of the mucous membrane of the digestive canal is shown by marked dryness of the mouth and excessive thirst: all which conditions of the capillary system may be considered as *symptoms* in disorders of the heart.

> "He had a *fever* when he was in Spain,
> And when the fit was on him, I did mark
> How he did *shake*; 'tis true, this god did shake;
> His *coward* lips did from their *colour* fly;
> And that same eye, whose bend doth awe the world,
> Did lose its lustre. I did hear him groan;
> Ay, and that *tongue* of his that bade the Romans
> Mark him, and write his speeches in their books,
> Alas! it cried, 'Give me some *drink!*'"
>
> Shakspere.

There is no more striking symptom in affections of the heart indicated by changes in the cutaneous capillaries than a sensation of *coldness*, more especially in the hands and feet, and sometimes extending over the whole cutaneous surface, caused by a diminution of blood in the capillary system.

Case.

The coldness of the feet and limbs from *pulmo-cardiac congestion* was instantly and permanently relieved in a young lady when leeches were applied to the cardiac region.

CHAP. XIX. Accompanying coldness there is always more or less paleness; or the skin may be of a livid colour. In the first case the blood, both in the arterial and venous capillaries, is diminished, whilst in the latter there is a congestion of blood in the venous capillaries.

The coldness of the cutaneous surface is often accompanied by *shivering*, and this condition is frequently the prelude of those *fits* which are caused by a disordered circulation.

Case. A youth who for many years suffered from a disease of the heart, the most prominent symptom of which was a painful sense of coldness in the hands and feet, which were swollen and of a deep livid hue. The state of the heart being greatly improved by cardiac remedies, the amendment was strikingly marked by a return of the natural heat and pallid colour of the hands.

A hot, arid, or parched state of the cutaneous surface is frequently observed in a disordered circulation, and is accompanied by a corresponding redness or flushing of particular parts of the skin, of the face, and of the hands and the feet.

Perspiration, more or less profuse, in diseases of the heart, is generally accompanied by coldness of the skin.

Case. A lady was completely relieved of difficult breathing, and of other symptoms accompanying a disordered heart of long duration, by a profuse *perspiration*—strikingly exemplifying the connexion between the heart and the cutaneous capillaries.

The capillaries of the *gastro-pulmonary mucous* membrane are no less under the influence of the action of the heart than the capillaries of the cutaneous system; and all the changes which the pulmonary mucous membrane undergoes assist in forming a correct diagnosis of the condition of the heart.

I have already noticed the remarkable effects on the functions of the heart which are produced by the application of cold or heat upon the mucous system. On the other hand, remarkable changes may be observed in the functions of the capillaries of that system in diseases of the heart.

In acute diseases of the heart accompanied by fever, we observe how greatly the mucous surface of the alimentary canal is influenced, and its functions disturbed, in the same manner as has been remarked of those of the external skin. The mouth becomes parched and dry, causing thirst; and that portion of the membrane covering the tongue becomes thickened, its colour is altered, and a milky-coloured mucus is deposited on its surface.

This state of the mucous membrane of the mouth is accompanied by a corresponding change in the functions of the stomach. The appetite is impaired, the powers of digesting solid food cease, and, where an opportunity was obtained of looking into the stomach, its interior surface was seen to be pale and dry.

Case of Martin, the Canadian.

The *thirst* which those experience who are suffering from febrile diseases, seems to be an instinctive appetite to supply the body with liquids which are required when in this state of fever; just as hunger causes an appetite for food when the system requires to be replenished.

In the *chronic* diseases of the left heart we seldom observe any symptoms of affections of the stomach; but in affections of the right heart, the digestive apparatus is more or less influenced and deranged, especially the chylopoietic viscera.

When noticing the symptoms of diseases of the heart derived from the respiratory organs, I mentioned that a *spontaneous bleeding* from the gastro-pulmonary mucous surface is one of the most unequivocal. Hæmorrhage, however, in disorders of the heart does not always take place, only from the pulmonary portion of the mucous surface, but also from the Schneiderian membrane, and from particular portions of the mucous membrane of the intestinal canal. Hence the epistaxis, the vomiting of blood, and the hæmorrhoidal flux, all which we shall more particularly consider, when treating of the symptoms derived from the digestive organs.

Œdema.

A *serous effusion* into the cellular tissue, like most other symptoms of a diseased heart, takes place in every possible degree, though it usually escapes observation until the more advanced stages.

In all cases where the circulation has been disturbed, even for a very short period, it will be usually found that the face becomes puffy, leading those around the sufferer to consider him comparatively in health and "getting fatter." One or both feet at the same time begin to swell from the serous infiltration; and as the organic changes in the heart advance, symptoms supervene, which show that the pericardium and cavities of the pleura have also become more or less distended with serum.

Here I may allude to a pathological observation of the ingenious Bichat, that "*œdema* appears only until *after* effusion has taken place in the serous cavities which immediately surround the diseased organ; so that, when affections of the heart are accompanied by œdema, we may infer that a corresponding effusion has already taken place in the pericardium. When effusion takes place within a serous cavity, in consequence of some disease of the organ unconnected with the membrane, the serosity is limpid, transparent, such as that which circulates in the lymphatic vessels; but when the hydropsy depends upon a disease of the serous membrane itself, fleaks of albumen are deposited upon its surface, and the collected serosity is then changed, becoming milky."

Anatomie Générale.

From this observation we may infer that, in diseases of the heart, those of the pericardium are accompanied by effusion of serum, as well as by lymphy depositions; but those of the cavities of the heart and their lining membrane, are accompanied with limpid and purely serous effusion into the pericardium.

Towards the fatal termination of diseases of the heart, I have, in a few instances, observed that the serous effusion is greatly diminished. In two cases where there had been universal anasarca, the swelling of the limbs suddenly and completely disappeared a few days before death.

Change in colour of the hair.

The changes which are produced by disturbances of the heart upon the *cutaneous capillaries* are illustrated in a striking manner in persons where the *hair* of the head has suddenly become *white* from a disturbance in the heart caused by violent mental excitement.

> "My hair is grey, but not with years,
> Nor grew it white
> In a single night,
> As men's have grown from sudden fears."

Byron.

Case communicated by Mr. Faxon.

"A lady who was deeply grieved on receiving the intelligence of a great change in her worldly condition, and who had a remarkable quantity of dark hair, on the following morning the whole of the hair had become of a silver white."

Other instances of this kind are narrated by historians.

Cases.

"I was struck," said Madame Campan, "with the astonishing change misfortune had brought upon Maria Antoinette's features: her whole head of hair had turned almost *white* during her transit from Varennes to Paris."

The Duchess of Luxembourg was caught, when making her escape during the terrors of the French revolution and put into prison: the next morning her hair was *white*.

A Spanish officer, distinguished for his valour, was in the Duke of Alva's camp; an experiment was made by one of the authorities to test his courage. At midnight the "provost-marshal," accompanied by his guard and a confessor, awoke the officer from his sleep, informing him that, by order of the viceroy he was to be immediately executed, and that he had only a quarter of an hour left to make his peace with Heaven. After he had confessed, he said that he was prepared for death, but declared his innocence. The "provost-marshal" at this moment burst into a fit of laughter, and told him that they merely wanted to try his courage! Placing his hand upon his heart, and with a ghastly paleness, he ordered the "provost" out of his tent, observing, that he had "done him an evil office." The next morning, to the wonder of the whole army, the hair of his head, from a deep *black* colour, had become perfectly *white!*

Howell's Letters.

> "To be thus
> Grey-hair'd with anguish,
> Like those blasted pines,
> Wrecks of a single winter."

Shakspere.

CHAPTER XX.

SYMPTOMS OF DISEASES OF THE HEART DERIVED FROM THE DIGESTIVE SYSTEM.

Connexion of the heart with the organs of digestion; symptoms derived from disorders of the stomach; nausea; sickness; vomiting; vomiting of blood; discharge of blood from the rectum; symptoms derived from the biliary organs.

Among the phenomena in the cerebral, respiratory, and vascular systems, we have hitherto sought for the most remarkable *symptoms* in the disorders of the heart, there are, however, other systems from which symptoms of a diseased heart equally important, though not so numerous, may be derived.

When alluding to the reciprocal influence of the heart and digestive organs, I have remarked how much the functions of the heart were under their influence, how frequently disorders of the digestive organs disturb the functions of the heart, and how symptoms of disorders of the heart may arise either from disturbances in the functions of the stomach, of the intestinal canal, or of the biliary organs.

Symptoms derived from the stomach.

Though the stomach may be, according to Hunter, considered as the seat of "universal sympathy," and that many of its diseases exercise a great influence upon the circulation, yet the heart, when disordered, does not, in its turn, cause so frequently disturbances in the stomach. Indeed, the relation between the stomach and the heart is quite of a different character from the relation of the heart to the respiratory and cerebro-spinal systems. The intimate relation of the lungs and the brain to the heart, I have endeavoured to show, depends upon the *blood;* whereas the consent between the heart and the stomach depends entirely upon the *nervous* system.

Of the symptoms in disorders of the heart derived from derangements of the stomach, the most remarkable are *nausea*, *vomiting*, and *hæmorrhage*.

Vomiting.

I have already endeavoured to point out that *vomiting* is one of those instinctive acts of the economy—a striking example of the *vis medicatrix*—which is resorted to, not only for evacuating from the stomach any noxious food, but also for the purpose of restoring the balance of a disturbance in the thoracic circulation.

The disorders of the heart wherein vomiting occurs, may arise from different causes—as syncope—the hysterical and epileptic paroxysm—mental excitement—the unaccustomed motion of turning round rapidly—or sailing in a ship. It is in order to restore a disturbed circulation that vomiting takes place in the different states of the system, which have now been enumerated; and in each of which the functions of the heart are deranged; so that vomiting ought to be considered an essential *symptom*, though it has not, as far as I know, been noticed by any of those authors who have treated of the semeiology of the heart.

It must, at the same time, be remembered, that vomiting may arise from other causes besides a disordered heart. The passage of a renal calculus into the bladder, of a biliary calculus into the duodenum, a pregnant uterus, or a portion of strangulated intestine, are all accompanied by sympathetic *vomiting*.

Case.

A youth complained of a sense of nausea, and sometimes of vomiting, with which he had been afflicted every morning for several months. As he had no symptom of derangement in any of the digestive organs, my attention was directed to the circulation. The radial pulse was small, contracted, and of natural frequency; but the heart's impulse was greatly increased. Leeches were applied to the precordial region, and, notwithstanding the condition of the stomach, a quarter of a grain of the tartarized antimony was given twice a day; by this treatment the disorder of the heart was relieved, and the sickness never returned.

Hence, some who have a disease of the heart suffer very severely from sea-sickness, whilst healthy people who are sea-sick experience temporary relief from the act of vomiting. An emetic may often be had recourse to with advantage for restoring a disturbed circulation. Thus we can account for the good effects of artificial vomiting in some *coughs;* an indication that the cough in such cases was caused by a disturbance of the heart.

Whenever nausea or vomiting is observed without any other symptom of digestive derangement, or of gestation, or any symptom which would lead to the suspicion of the head being the seat of disease, or of a stone passing along the biliary ducts or ureter, we may then conclude that some disorder of the *heart* is the cause of the vomiting; whilst, on the other hand, whenever nausea and vomiting occur, accompanied with the ordinary signs of cerebral, biliary, or digestive derangement, then we may confidently conclude that they are not caused by, or that they are not symptomatic of, a disturbed heart.

Nausea with vomiting,

Though there may be vomiting without nausea, or nausea without vomiting, yet they are generally together; forming, as it were, two distinct stages of one act: the condition of the circulation appears to be so different in the two stages, that at first sight the sensible effects of each upon the system seems quite incompatible with their performing conjointly only one office in the economy. In a pathological point of view it is necessary to consider them separately.

Nausea greatly lowers the action of the heart, and diminishes the powers of life. Antimonials, by the nausea which they produce, are therefore employed to diminish the vigour of the circulation in inflammatory diseases, and are successfully administered, either singly or in conjunction with blood-letting—the effects of nausea and of the abstraction of the vital fluid upon the heart being equivalent.

The act of *vomiting*, on the other hand, appears to be purely mechanical, the abdominal muscles and diaphragm squeezing the stomach and forcibly evacuating its contents, propelling the venous blood to the right heart, and impeding the flow of the systemic blood in the great arterial trunks.

their effects explained.

Such being the differences in the effects of nausea and vomiting upon the circulation, we are naturally led to consider how they are combined in order to perform what appears to be only one act of the economy. To me it seems probable that by *nausea* the action of the heart is so greatly diminished in vigour, and the velocity of the blood so much lessened, that the vomiting which succeeds is better enabled, by its mechanical action on the heart and vascular system, to restore the balance of a disturbed circulation, than it would have been able to effect, had the action of the heart been more vigorous, and had the stream of blood passing through its cavities flowed with greater velocity.

In corroboration of these views of the nature and purposes of the two stages of this act, it may be remarked that the vomiting which is *preceded* by a protracted nausea is an instinctive act employed for restoring a disturbed circulation; whereas vomiting employed to evacuate the stomach of pernicious contents is *not* preceded by nausea, properly so called, but only by the momentary sensation of *sickness*.

That there should be some wise purpose fulfilled by nausea and vomiting being thus combined and co-operating with each other to execute one particular act, cannot be doubted; and observing other acts of the economy, we perceive that in some of these the same principle is resorted to; two processes which are apparently quite dissimilar being employed by the *vis medicatrix* to execute only one purpose. For instance, no two processes can be more dissimilar than syncope, and that which is employed by nature to arrest the bleeding from a divided artery, and yet to fulfil this important purpose, two processes are required. To arrest hæmorrhage, the mouth of the bleeding vessel should be closed by a coagulum of blood; to accomplish the process of coagulation, and in order that the blood may the more speedily coagulate, it is also necessary that the momentum of the stream be greatly diminished: thus the first effect of the hæmorrhage is to produce a fainting state, or syncope, by which the circulation becomes languid, and favours the formation of a coagulum.

Confirmatory of the preceding views on the nature of nausea and vomiting, I may allude to the different effects which are produced by different *emetics*, some as mustard, and ipecacuanha, merely evacuating the stomach, whilst others, as the tartarized antimony, besides producing *vomiting*, first causes a protracted *nausea*.

Whatever be the explanation offered of the phenomena of nausea and vomiting, practical men seem to be quite aware of the difference in the effects of different kinds of emetics in the treatment of diseases; vomiting being employed merely to empty the stomach, and nausea with vomiting resorted to with a view to relieve the condition of the circulation in febrile disease, and also in those affections where the functions of the heart are more immediately disordered. Hence we may account for the different opinions that have been given of the effects of emetics in some diseases, such as in hæmoptysis; for we can readily understand how nausea with vomiting should relieve the hæmorrhage, and excessive vomiting without nausea increase it.

Sickness, I may remark, must not be confounded with nausea; the terms are not synonymous.

Sickness differs from nausea.

It appears to me that by *nausea* is understood that peculiar sensation which is felt in those disturbances of the heart, where vomiting is resorted to by the economy for restoring the circulation; whereas *sickness*, properly so called, only precedes the vomiting which is resorted to for the purpose of evacuating from the stomach some offensive contents. Hence the common expressions of "sickness at stomach" and "sickness at heart" are pathologically correct.

Vomiting of blood.

When inquiring into the symptoms, in diseases of the heart derived from the respiratory organs it was mentioned that a *spontaneous bleeding* from the gastro-pulmonary mucous surface is one of the unequivocal symptoms of a disordered heart, and that this spontaneous hæmorrhage does not only take place in disorders of the heart, either from that portion of the mucous surface of the lungs, or from the Schneiderian membrane, but also from particular portions of the mucous membrane of the alimentary canal,—and hence *vomiting* of blood, *intestinal* hæmorrhage, and *epistaxis*.

Case.

A lady was deeply afflicted at the loss of her child, in a few hours she was attacked with vomiting, which continued unabated for ten days. She then vomited a large quantity of blood; the vomiting never returned, though she long afterwards suffered from a disordered heart.

Intestinal hæmorrhage.

The *hæmorrhoidal flux*, of which so much has been said by the elder pathologists, is a frequent symptom of a disordered heart—more especially the pulmonic heart; for, whenever the inferior *cava vein* cannot readily empty its blood into the right auricle, the whole portal system becomes congested, and an effort is then made to relieve the system by the hæmorrhoidal flux; in the same manner as cerebral congestion is relieved by epistaxis, and pulmonary congestion by hæmoptysis.

It is by this connexion of the heart with the *portal* system we can satisfactorily explain the beneficial effects that have always been attributed to the loss of blood from the hæmorrhoidal veins in congestion not only of the right heart, but of the cerebro-spinal and pulmonary systems: this connexion justifies the important practical inference, so universally established of the danger of employing means to arrest suddenly the hæmorrhoidal flux. Many are the cases, where the most distressing symptoms, as cerebral apoplexy, and hæmoptysis, have arisen from the disturbance to the circulation which has been caused by a sudden suppression of the hæmorrhoidal flux.

From the observations that have been made on the morbid condition of the *liver*, and of the derangements in the portal system in those diseases especially which affect the right heart, *symptoms* will also be manifested in the chylopoietic viscera which will assist in pointing out the heart's condition. Besides an engorgement of the portal system, the functions of the liver become deranged, and the quantity and quality of the bile variously altered,—changes in the biliary secretion, which, by their influence on the digestive process, cause derangements in the functions of the intestinal canal as well as in those of the kidneys.

These observations, however, apply only to the disorders of the *right* heart; for as the arterial system of the abdominal viscera has no peculiarity in its arrangements, and as there is no vascular distribution such as that subsisting between the portal system and the right heart, consequently we may anticipate that there will not be that connexion in the diseases of the left heart with the digestive system, which subsists between that system and the right heart.

This view accords with all the observations that I have been able to make on the diseases of the two hearts; for in the various organic diseases of the *left* heart, I have found that the state of the organs of digestion was, in most instances, healthy, though, undoubtedly, a disease of the left heart may exist at the same time with a derangement of the *primæ viæ*.

It is of importance to bear in mind this observation, when considering the diagnostic symptoms of organic disease of the heart—whilst a deranged state either of the digestive or nervous system may produce sympathetic affections of the central organ, the absence of all derangement in either of these systems may be taken as a strong indication that there is some primary affection in the heart.

CHAPTER XXI.

SYMPTOMS DERIVED FROM THE MUSCULAR SYSTEM.

Involuntary action of the muscles in diseases; they are resorted to by the vis medicatrix naturæ; *they are symptoms of a disturbed circulation; different characters of these muscular movements; differences in those of animal, and of organic life.*

Having pointed out the reciprocal influence of the heart and the muscular system, when the body is in health, we are also led to inquire how these organs influence each other in disease.

Involuntary action of the muscles in diseases.

It has been also pointed out, that the various changes in the circulation which are constantly taking place in the different organs when they are in health, are all changes required for the due performance of their special functions; and that the economy resorts to certain means—to instinctive acts—by which the balance of the circulation, whenever it is interrupted, can be restored; and, likewise, that these acts are resorted to by the *vis medicatrix*, to mitigate and subdue disease.[1] Thus, whenever the muscles of animal life are thrown into involuntary movements, such movements are caused either by some primary disorder of the cerebro-spinal system, by some disorder in the *primæ viæ*, or by what I believe to be most frequent—a disturbance in the functions of the heart.

They are employed by the *vis medicatrix.*

Pathologists are quite familiar with the immoderate fits of laughter, the screaming, the sobbing, and the sighing during an hysterical paroxysm; the yawning, the convulsive movements of the limbs, and the vomiting, in persons recovering from a state of syncope. But the precise changes which these different movements produce on the circulation have neither been explained, nor have they ever been enumerated in the catalogue of *symptoms* of diseases of the heart; most of them having been considered and arranged by nosologists as primary affections of the nervous system.

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[1] "The affections of the motions and moving powers of the animal economy must certainly be the leading inquiry in considering the diseases of the human body."—Cullen.

Differences in these muscular movements.

In disorders of the heart, either all the voluntary muscles, or only some particular muscles, are convulsed; whilst in other cases, both the voluntary and the involuntary muscles are convulsed simultaneously. Sometimes there is a succession of involuntary movements; sometimes the muscles are permanently contracted, as in tetanus and cramp; sometimes they are almost constantly in action only during wakefulness, as in chorea; and sometimes the same muscles are alternately convulsed and paralyzed.

Differences in those of animal and of organic life.

"Nothing is more common than to see the abdomen and thorax having their ordinary muscular movements, whilst the limbs are agitated with convulsions; or the abdominal and pectoral muscles continuing to act, whilst one of the superior or inferior extremities is completely paralyzed."

Bichat.

However difficult it may be to explain satisfactorily the effects of the muscular movements which accompany some diseases, such movements must, undoubtedly, be intended to serve some important purpose, from their influence on the circulation of the blood. Thus, whatever be the organ or system primarily affected in *tetanus*, the permanent contractions of so many of the voluntary muscles, which form the essential feature of that disease, must materially influence the circulation, by impeding the transit of the blood, not only in the arteries which are imbedded in the contracted muscles, but also by obstructing the free circulation in the arteries adjacent to the contracted muscles must increase the quantity of blood in the cavities of the heart. The effect of abstracting some blood from a vein has been so decidedly beneficial in some cases of tetanus, and, likewise, the good effects of tobacco, which acts so powerfully on the heart, appear to me to point out the presence of a disordered state of heart in that disease and a rational system for the treatment of that fearful malady.

Muscular contractions in tetanus,

and in cramp.

The condition of the muscles in *cramp*, such as often affects the "gastrocnemius muscle," by the fatigue of dancing, are also accompanied by a disturbed heart. The contractions of the muscles of the leg usually come on at night, in those persons who are suffering from indigestion; the loaded stomach disturbing the heart.

Case.

A man with "tuberculated lungs," who suffered also from a congested heart, applied three leeches to the cardiac region, by which not only the embarrassed breathing was relieved, but a painful cramp in both legs, which had attacked him every night for six weeks, on his lying down in bed, and which usually lasted half an hour, never returned after the loss of blood.

The "shivering" in the cold stage of fever, and the "shaking palsy" are also examples of muscular movements, which must have a great influence on the circulation; and those involuntary movements which accompany "dentition" and "worms," reasoning from analogy, must serve some important purpose in the animal economy.

CHAPTER XXII.

SYMPTOMS OF DISEASES OF THE HEART DERIVED FROM THE UTERINE SYSTEM.

Connexion of the heart and uterus; suppressed menstruation; *irregular and painful menstruation; cessation of the menstrual flux; uterine hæmorrhage; physiological symptoms concluded.*

Symptoms derived from the uterine system.

Much as the functions of the heart are influenced by the function of the uterine system, in an equal degree is the uterine system influenced by disorders of the heart; and, like the stomach, this connexion between the heart and the uterus depends upon the nervous system.

The *symptoms* of diseases of the heart afforded by the *uterine system* are, however, few, because, except when the uterus is in the impregnated state, the only function which it performs is that of menstruation.

The menstrual flux may either be increased or diminished, become irregular, or it may completely cease. During these changes in the uterine functions, those of the heart are more or less disturbed, so that the condition of the uterus will be found in many instances to be the effect of some primary affection of the heart.

Obstructed menstruation.

There is no more common symptom of a disordered heart in women than the *non-appearance* of the catamenia at the age of puberty. The great convulsion which takes place at that eventful period of woman's life, renders her very susceptible of disease. The mind being at that time easily excited, and the passions less under control, it frequently happens that the heart's functions are disturbed, and that the uterine system is, more perhaps than any other, influenced by the disordered circulation,—so much so, indeed, that sometimes the essential function of menstruation is never performed. In such cases the heart is usually more or less congested, and, the blood being imperfectly circulated in the different organs, these organs are variously affected by the unequal supply which they receive of the vital fluid, some having too small, and others too large a quantity for the performance of their healthy functions.

Irregular menstruation.

No less frequently are disorders of the heart accompanied by *irregularities* of the menstrual flux; these irregularities consisting of differences in the quantity or in the quality of the excreted fluid, and of differences in the periods of the accession and of the duration of the excretion.

The varied changes in the function of menstruation most frequently accompany those changes in the heart's functions which are produced by moral causes; and, therefore, many of the remedial means which are most useful in restoring the uterine functions are those that have a specific effect upon the organs of circulation—a depletive system relieving an interrupted and diminished menstrual discharge, and the preparations of steel, zinc, and lead relieving uterine hæmorrhage.

Menorrhagia.

Besides irregularities in the menstrual flux, the mucous membrane of the uterus is liable to spontaneous *hæmorrhage*. Such hæmorrhages are often connected with a disordered heart; and, in many instances, the discharge appears to be resorted to by the economy in order to relieve congestion of the heart, in the same manner as congestion is relieved by a spontaneous bleeding from different portions of the gastro-pulmonary mucous surface.

Such uterine hæmorrhage may take place immediately after the cessation of the menstrual flux; it may accompany that excretion so that the menstrual fluid is mixed with healthy blood; or the hæmorrhage may occur at any time between the menstrual periods.

In these different derangements of the uterine functions, the action of the heart is often disturbed; and, as has been already mentioned, the remedies which are most useful in such disorders are chiefly those which act upon the heart.

Conclusion.

Thus far I have endeavoured to arrange and explain the nature of the numerous symptoms which, in the diseases of the heart, are derived from the effects of a disturbed circulation upon the different organs and systems of the economy.

When it is considered that the function of the heart and its vessels is to convey throughout the whole frame that vital element by a due supply of which alone can its various functions be executed, it might have been anticipated that each organ would be materially influenced and deranged, whenever the heart with its vascular apparatus did not supply them with the requisite quantity of blood.

It might, too, have been anticipated that, in the maladies of the heart, not only one of the systems of the economy, but that several, or even all of them might be simultaneously affected; so that the symptoms—the *physiological* symptoms—would be numerous, and would be variously combined in the different diseases.

Contemplating these physiological symptoms, and seeing how varied they are in their number, as well as in their combinations, we might have also anticipated that particular symptoms and particular assemblages of symptoms would appertain to particular diseases. But, in prosecuting this inquiry, we meet with numerous difficulties, we find that many diseases which appear similar, as far as our knowledge enables us to judge, are attended with very dissimilar symptoms; and, likewise, that similar symptoms are met with in diseases which are of very different characters.

The only arrangement which it appears to me, can be judiciously made of the physiological symptoms that have been enumerated, is by classifying them into those symptoms which belong to either of the two hearts; those of the *right* heart belonging to changes in the *venous*, and those of the *left* heart to changes in the *arterial* system.

But even this subdivision of the symptoms is not always practically correct; as in many examples of the heart's diseases, both the venous and the arterial circulation is deranged; so that symptoms are then present, which belong to both the systemic and pulmonic heart.

On this part of the work, which professes to treat of the *semeiology* of the heart, I have dwelt the more fully; being strongly impressed with the opinion, that, if the account which has been given of the *physiological symptoms* be correct, it will materially contribute to enable the practitioner of the healing art to discriminate with more accuracy, and administer remedies with more confidence than hitherto; and thus he will be the better enabled to avoid those serious mistakes which daily experience must convince every inquiring and impartial mind are constantly made. At the same he will be aware of the imperfections and fallacies which inevitably result from relying chiefly on *physical* signs in the diagnosis of the heart's diseases.

The observations which have been made on the physiological symptoms, I may further remark, have been the result of long experience and multiplied observation. I have also made them the subject of repeated conversation with those on whom I could rely for their judgment and their unprejudiced minds. I have therefore with the more confidence presented them to the indulgent reader.

To the quotations which have been occasionally made from the works of history and fiction I may here allude; for it is remarkable that these quotations should convey a more lucid explanation of some of the phenomena of the economy, than are to be found in the contemporary works of any of the most distinguished physiological writers.

It may also be remarked, that these inquiries into the physiological symptoms of the diseases of the heart have been conducted without having had recourse to *experiments* on living animals. I have been long convinced that a knowledge of the healthy structure and of the healthy functions, as also of the diseased structures and of the diseased functions, is the sure guide to follow, when investigating the nature of diseases of the different organs, and establishing the most appropriate principles for their treatment.

In the dark ages, when the dissection of the human body was prohibited, it is not surprising that inquiring minds should have resorted to the dissection of animals; and that, when they had become acquainted with their structure, they should have been arrested by the phenomena exhibited by inspecting them when alive. But since human anatomy has been so fully investigated, and a rational physiology, founded upon the solid basis of the structure of the body, has been revealed, experiments on animals have contributed but little to advance physiological science. On the contrary, the discordant results, and the false theories and hypotheses that have been built upon these experiments, have greatly encumbered and checked the progress of sound inquiry.

"How is it that, if experiments be worthy of the confidence which some have reposed in them, the most able physiologists are continually at variance as to the facts elicited from them,—one thing being observed by one experimenter, and something quite different, even diametrically opposite, by another? Inferences drawn from an experiment on an animal are not always applicable to man; neither is an experiment on one class of beings applicable to the other classes." Magendie.

CHAPTER XXIII.

THE ANATOMICAL SYMPTOMS OF THE DISEASES OF THE HEART.

General observations on the anatomical symptoms; they are to be discriminated by the senses of touch and of hearing; importance of the anatomical symptoms; enumeration of the anatomical symptoms; the impulse; it is the measure of the force of the heart; its variations both in health and in disease; its importance in semeiology.

The class of symptoms which I have hitherto investigated arise entirely from, or are the effects of, that influence which disturbances of the circulation create on those organs with which the heart is most intimately associated. We now come to the consideration of those symptoms which have been denominated the *local* or *anatomical* symptoms, and which are recognisable by the senses of an observer; the physiological symptoms being perceptible only to the patient himself.

In the diseases of the internal viscera, such as those of the liver, the anatomical symptoms are pointed out by observing, through the integuments, such alterations in the form of that viscus as are perceptible by the senses of touch and of sight, and by testing different degrees of its sensibility. In affections of the brain, besides the physiological symptoms, there are morbid sensations in the head felt by the patient himself, such as headache, giddiness, or tenderness to the touch.

But, in the disorders of the heart, in addition to visible changes in the form of the parietes of the chest, in their sensibility to the touch, and in the nature of the contents, whether solid, fluid, or aeriform, there are local symptoms,—one order of which is derived from changes in the blow given to the walls of the chest by the heart itself, and another from changes in those sounds which are caused by alterations in the currents of the blood passing through the heart's cavities.

As every alteration in the structure and functions of the heart is accompanied by a corresponding change in its *impulse*, in its *sounds*, in its *rhythm*, in its *form*, or in its *sensibility* to the touch; and as all these changes constitute an essential class of *symptoms* in the heart's disorders, each symptom merits a separate consideration.

Symptoms derived from Changes in the Impulse of the Heart.

Viewing the heart simply as a physical apparatus, it must not, however, be compared, as it has often been, to a common syringe employed merely for the purpose of propelling the blood into the arterial system. It ought, on the contrary, to be considered as an engine composed of separate compartments; each of which is endowed with contractile powers for evacuating its fluid contents,—the right heart propelling the venous blood into the lungs, and the left heart injecting the arterial blood throughout the system; so that the changes produced in the form of the heart by its alternate contractions and dilatations, cause considerable movements in its soft parietes,—movements which are communicated to the contiguous solid walls of the chest. By placing the hand upon the precordial region, we are able to feel the movements of the heart; and the shock or *impulse* which is caused by its "tilting" may be taken as a measure of the increase and diminution of the force of its contractions.

The impulse is a measure of the heart's force.

The differences in the impulse of the heart are very considerable even in its healthy condition; these differences arise either from peculiarities in the natural form; from the thickness of the walls of the chest; from differences in the bulk of the heart; or from differences in the natural vigour of the constitution. Hence it is that, in common language, we talk of a heart "bounding with joy," and of a heart "subdued by sorrow."

"The *force* of the heart," observes Senac, "is constantly varying. The vicissitudes of age, the impressions of surrounding bodies, food, or abstinence, all influence its movements;"—and the *frequency* of the beatings of the heart is usually increased with the impulse.

In order, therefore, to be able to form a just estimate of the variations in the impulse of a diseased heart, we must first become acquainted with its variations in healthy persons. We are struck in a particular manner by the great *increase* in the impulse, when the heart becomes gorged with blood; which takes place after any violent exertion; and with a *diminution* in the impulse, or with its becoming even imperceptible, in those persons who are suffering from debility or temporary exhaustion, as we see exemplified in syncope.

Having by the exercise of the sense of touch become familiar with the temporary alterations, to which the impulse of the heart is constantly liable in health, we are then prepared to examine its changes in disease.

Changes in the impulse;

The impulse varies in every possible degree in the different morbid conditions of the heart. Sometimes it is scarcely perceptible, and sometimes it gives a shock to the chest so severe as to cause it not only to be felt by the patient himself, but to be perceptible even to those present.

its increase;

An increased impulse of the heart indicates two very different conditions of the circulation in the arterial and capillary systems. If there be an increased impulse without any organic change in the heart, the whole vascular system is affected, as may be observed in febrile diseases. But if there be an increased impulse from an impediment to the transit of the blood, causing the heart to act more vigorously in order to overcome an obstacle, then, in place of an increased vascular action, the vigour of the circulation in the arterial and capillary systems is diminished; so that in such cases the cardiac and arterial pulses do not correspond.

> "My heart beats thicker than a fever'd pulse."
>
> (Shakspere)

its diminution.

When in affections of the heart the impulse becomes extremely feeble, or even quite imperceptible, such a languor of the circulation may arise either from general debility, or it may be caused by some mechanical obstruction to the circulation, producing an accumulation of blood within the heart's cavities, which they have not the power to expel.

Palpitation.

But when the intensity of the impulse is so much increased that the beatings of the heart are even perceived by the patient himself, it has then been considered a distinct disease, and called *palpitation*. It is evident, however, that this term designates only a symptom, as palpitation accompanies many of the diseases of the heart.

"The motion thus named is a contraction or dilatation of the heart that is performed with more *rapidity*, and generally also with more *force*, than usual; and when, at the same time, the heart strikes with more than usual violence against the inside of the ribs, producing often a considerable *sound*."

Cullen.

The impulse differs during expiration and inspiration.

Whilst examining the heart's impulse, it will be of consequence to notice its differences, both during expiration and inspiration; for it is clear that, during inspiration, when the air-cells of the lungs are fully distended, the beatings of the heart will be less forcible than during expiration, the lungs then being comparatively in a state of collapse; consequently the blow given by the heart to the parietes of the chest will be much stronger during expiration than during inspiration. For the same reason the second stroke of the heart is louder than the first; the third is weaker than the first; and the fourth still weaker than the third,—a fact easily ascertained by personal examination.

and in the different attitudes of the body.

So, likewise, must the impulse of the heart be modified in the various attitudes of the body. When a person has been for some time in a recumbent posture, and the breathing is calm and undisturbed, the heart's pulse will be observed to beat precisely four times during each act of aspiration.

In conclusion, I may observe that, as the increase in the action of the muscles of the heart depends on the quantity of its blood—various causes altering the quantity of the blood within the heart—and as disturbances in the functions of the coronary arteries, and morbid changes in the heart's parietes must also disturb the functions of the muscles, changes in the impulse will therefore take place in almost every disorder of the heart.

CHAPTER XXIV.

THE ANATOMICAL SYMPTOMS OF THE DISEASES OF THE HEART.

Symptoms derived from the sounds of the heart caused by the blood's currents; illustrated in external and in varicose aneurisms, and in the diseases of the valves; causes of changes in the currents; changes in the two audible sounds; the sense of hearing requires culture; its acuteness varies in different persons; how the sounds are changed in particular diseases; names by which the different sounds are designated; mode of examining the sounds by the naked ear, and by the stethoscope; use and abuse of the stethoscope.

Essential as a familiar acquaintance with the impulse of the heart may be when investigating its varied morbid conditions, of equal importance is a knowledge of the changes in the *sounds.*

The sounds are caused by the currents of the blood.

As the two sounds perceptible to a common ear, when placed upon the præcordial region, are caused by the *currents* of the blood flowing through the cavities of the heart, every change in the form of these cavities, either from an alteration in the structure of their walls, or of the valves of their communicating orifices, must alter the blood's currents, and produce corresponding changes in the sounds.

The true aneurisms illustrate this;

External *aneurisms*, I have already remarked, afford most favourable opportunities for observing sounds produced by alterations in the currents of the blood; the *whizzing* noise, so characteristic of the aneurismal swelling, being caused by the stream of blood which passes out of the natural channel of the artery through the mouth of the aneurismal sac, and repasses from the aneurismal sac into the artery. And still more characteristic is the sound produced in the *varicose aneurism* by the current of blood which passes through the artificial orifice that has been made in the artery; and also by that current which passes through the corresponding opening made into the vein. The

also the varicose aneurism,

(*Med. Obser. and Inq.*, vol. ii.)

sound which is produced by these two currents, was described by W. Hunter, "as if there was a blast of air passing through a small hole, like what is produced in the mouth by continuing the sounds of the letter R in a whisper."

and the diseases of the valves.

A favourable opportunity for observing the effects of changes in the currents of the blood altering the sounds of the heart is also offered in those cases, wherein the *valvular* apparatus is diseased; such serious effects being sometimes produced in the blood's currents, as to cause not only changes in the natural sounds, but even to cause entirely new sounds.

Numerous changes in the blood's currents.

But changes in the velocity and in the direction of the blood's currents, it should be borne in mind, must be constantly taking place in the healthy condition of the body. The fact that the velocity in the *efflux* of the systemic blood, and the velocity in the *influx* of the pulmonic blood is always changing, and that the circumstance of the great inequality in the surface of the heart's different cavities which execute the important offices, not only of giving special directions to the currents, but also of mixing the bloods, must render the changes in the currents almost endless; and, although it be admitted that all such modifications will cause corresponding changes in the sounds, yet it must not be supposed, that these changes can be sufficiently intense to be recognisable by our sense of hearing.

When, however, changes in the currents of the blood do take place to a certain degree, the corresponding sounds may be sufficiently loud to become audible to a competent observer.

Subject to constant alterations, as the currents of the blood must indisputably be, in the different cavities of the heart in a healthy condition, what an endless variety will they not present when, from disease, interruptions more or less considerable are caused, either to the influx or to the efflux of the blood; or by the transit of the blood from the different cavities of the heart into one another? Indeed, the sounds in the heart must doubtless, though the ear may not be able to discriminate them, undergo changes as numerous at least as the beats of the arterial pulse which we are able to discriminate by the sense of touch—the pulse being nothing more than an indication of the alterations which take place in the current of the arterial blood as it leaves the heart.

Causes of changes in the blood's currents.

To elucidate still further these views, it will be well to state more in detail the changes in the central organ of the circulation which must modify the currents of the blood sufficiently to produce sensible alterations in the sounds of the heart.

Muscular exertions.

Inflammatory affections;

The increased rapidity of the circulation which arises from a severe muscular exertion; the effects of the full inspirations which accompany surprise, fear, and other mental emotions; and the influence of the digestive process upon the action of the heart, will, it cannot be denied, all produce changes, or at least temporarily modify the currents of the blood—all which changes may be recognised by corresponding changes in the arterial pulse. No less remarkable must be the effects of an irritable state of the interior surface of the heart, or of the *endocardium*, in changing the currents of the blood. Like an irritable urinary bladder, which is excited to contract by every spoonful of urine collected in it, so the irritable parietes of the heart's cavities will contract so frequently, that the currents of the blood must be greatly altered. A similar effect will also be produced by an inflamed state of any of the other structures of the heart; all these being exposed either directly to the stimulus of the vital fluid, or to the influence of the movements of the heart itself.

from a diminution of blood;

Essential differences in the currents will likewise arise, when there is a diminution in the quantity of the general mass of the blood, such as take place after a profuse hæmorrhage.

from structural change;

Considerable as the changes must be in the blood's currents within the heart from these different causes, still more remarkable are those changes which take place when there is any structural or permanent alteration in the form of the heart's cavities, more especially in their valvular apparatus.

in the right heart,

On viewing the structure of the right heart, we readily perceive, how much the currents of the venous blood must be altered by any structural changes which would have the effect of altering the direction or velocity in the stream of blood in either of the cavæ veins, or by any changes in the form of the right auriculo-ventricular or pulmonic valves.

and in the left heart.

So also the changes in the currents of the blood, and consequently in the sounds of the heart, must be equally numerous, when either the auriculo-ventricular orifice of the systemic heart, or the aortic valves, become altered in structure.

Thus it will appear, from what has now been stated, that the sounds of the heart must necessarily undergo an almost infinite series of changes; changes varying in degree from sounds caused by the smallest possible variations in the currents of the blood to sounds of so great an intensity as will completely alter the usual course of the vital stream, and not only change the intensity and character of the natural sounds, but will even produce entirely new sounds.

Only two sounds are audible.

Those minute changes in the sounds, and those which are merely transitory, cannot, as I have already said, be recognised even by the most acute ear, any more than the minute differences in the shades of colours can be discriminated by an untutored eye. It is only, therefore, when the natural sounds of the heart are considerably altered, that their changes can be at all recognised.

How these are produced.

There are only two sounds, as has been already remarked, of that infinite series produced by the various alterations in the currents of the blood within the heart of a person in health, which are sufficiently loud to be recognised by a common ear,—one of these being, probably, caused by the vital streams which are forced into the systemic and pulmonic arteries by the powerful ventricular contractions; and the other sound by the stream of blood which is propelled by the auricular contractions through the auriculo-ventricular apertures.

These being the two great and principal currents of the blood, we may legitimately conclude that the sounds caused by these currents must be the most audible; and that all the varieties in the sounds, which may be noted both in health and in disease, will probably be the effect of alterations in these two currents.

When investigating the particular diseases of the heart, we shall find that the sounds will sometimes be altered in their *seat*,—increased or diminished in their *intensity*,—the *space*, over which they are heard, may be increased or diminished,—they may be changed in *duration*,—their *tone* may be modified,—the *intervals* between them or the *rhythm* may be altered, or entirely *new* sounds may be produced.

Pathologists have long been aware, that changes in the structure of the parietes of the heart are accompanied by particular sounds, as well as by changes in the heart's impulse; but no pains were taken to discriminate the sounds from one another; far less to refer each of them to diseases of particular portions of the heart's structure until Laennec applied his ingenious and inquiring mind to this subject. It is, indeed, a curious circumstance, that they should have been satisfied with observing only the changes in the *arterial pulse*, and seldom or never examining the changes in the cardiac pulse, corresponding with the sounds of the heart; though they could not have been in the habit of examining the arterial pulse for any other purpose but to obtain information regarding the condition of the heart itself.

The sounds neglected by the older writers.

To acquire facility in discriminating the morbid sounds of the heart, it behoves us, as has been remarked when speaking of the arterial pulse and of the heart's impulse, first to become familiar with the natural sounds by carefully examining them in numerous healthy persons, by which we may be afterwards enabled to perceive those changes in the sounds which are caused by disease. In fact, the different morbid as well as the natural sounds must all be *heard* before they can be understood. The ear requires the same tuition to enable it to distinguish morbid sounds as the eye to discriminate the different shades of colours in diseased structures; and there are persons who have the faculty of being able to distinguish a great number of different sounds at the same time, as those of the different instruments in an orchestra.

The ear requires tuition.

It is well, however, to be aware, that the more minute changes in the heart's sounds cannot be perceived by all observers alike; for the acuteness of the sense of hearing, like that of sight, varies exceedingly in different people; and it frequently happens that a sound which is distinctly audible to one person, cannot be perceived by another. I am, therefore, convinced that there are many who do not possess the sense of hearing sufficiently acute to enable them, even after an attentive culture, to distinguish those nicer shades of difference in the sounds of a diseased heart which others may be able to discriminate; and from this may have arisen the numerous errors in *diagnosis* made by those who have alone trusted to their sense of hearing. It is told of a celebrated musician, that the nicety of his ear was such that he could distinguish the hundredth part of a note in music—

Differences in the acuteness of hearing.

Extraordinary acuteness in hearing.

an acuteness which may appear incredible: and it is well known that prisoners, who have been long in solitary confinement, acquire an extraordinary acuteness of hearing from the silence of their dungeon, and perhaps also from the ear not being excited, even by their own voice. Such, indeed, is the sensibility of the auditory organ, that when a person is in a situation of perfect and undisturbed tranquillity, as upon the top of a lofty mountain, and beyond the usual habitation of every animal, an accidental noise gives much uneasiness.

The same remark applies to the other organs of sense; for it is perfectly well known that there are individuals who possess the power of discriminating colours, tastes, odours, and tangible bodies with an extraordinary degree of nicety: all which instances of perfection in the organs of sense ought rather to be considered exceptions than a general attribute of man.

How the sounds are changed by diseases.

The variations in the heart's sounds being once established as signs in its diseases, and as a means to discriminate the alterations which the heart's tissues undergo, pathologists were naturally led to inquire what were the changes of structure in the heart by which each of the morbid sounds was produced? By comparing the sounds with the corresponding alterations in the heart's structure found after death, they have thus been able to refer particular sounds to diseases of particular parts of that organ, and to establish the varied sounds as an important branch of semeiology.

By way of illustrating the information to be derived from an acquaintance with the diseased sounds of the heart, let it be supposed that a peculiar sound has been recognised, which is known to be the effect of that alteration in the current of the blood caused by an aneurismal sac: whenever we meet with a patient in whom this peculiar sound exists, along with other symptoms which usually accompany aneurism, we are then able to pronounce with confidence the presence of that disease. The advantages in diagnosis, which are derived from a knowledge of the sounds which accompany alterations in the different tissues of the heart, are also well exemplified in diseases of the auriculo-ventricular orifices; changes in their valves producing peculiar sounds or *murmurs*, which are quite different from those sounds belonging to an aneurismal tumour. It is, indeed, easy to conceive how a very different sound should be produced when the circulation is obstructed by a thickened and unyielding valve, from that change in the current of the blood which is caused by the calibre of an artery being enlarged at a particular part.

There are, however, some sounds to which pathologists have not yet been able to connect accurately the corresponding changes of structure ; neither could it be reasonably anticipated, in many of those cases of disease, where there are several portions and several different tissues of the heart simultaneously affected, that in such complications much accurate information could be possibly derived from observing the varied sounds.

Names given to the sounds.

To the indefatigable labours of Laennec we are indebted for having pointed out the more important diseased sounds of the heart, to each of which he affixed a name. These names he chose from the resemblance in the sounds to sounds with which every one is familiar—such as the noise of a pair of bellows, the action of a saw or of a file, or the purring of a cat. In adopting this method, he followed the example of mineralogists, who have made a similar nomenclature with regard to colours, tastes, smells, and objects of touch, comparing each of these qualities with that quality belonging to some well-known animal, mineral, or vegetable substance. There is a figurative language used by painters and musicians, which is the only mode by which they can express the different shades and combinations of colours, and the various modulations and combinations of audible musical sounds.

It would, however, be in vain to attempt to describe and to distinguish by appropriate names all those nice variations in the sounds of the heart which accompany its numerous forms of disease. Such an undertaking would be just as futile as it would be for a painter to attempt to give an intelligible description of the infinite variety in the shades of the different colours in a picture. Indeed, what I have said of the difficulty in discriminating the varieties of the arterial pulse, is strictly applicable to the sounds of the heart.

Changes in the sounds enumerated.

As modifications in the sounds afford an important class of symptoms in diseases of the heart, it will be expedient to review them first in a general manner, and afterwards, when treating of particular diseases, to describe those sounds which have been discriminated as appertaining to each disease; at the same time it must be admitted, that there are many sounds which we are not able to explain, and which we cannot refer to any particular malady.

One class of sounds consists of changes in the two natural and audible sounds,—as alterations in their *seat*, *extent*, *intensity*, *rhythm*, and *tone;* and there are morbid sounds or *murmurs*, such as those of blowing and of friction, which accompany changes both in the functions and in the structures of the heart.

Changes in their seat.

With regard to the *seat* of the sounds, it sometimes happens that the position of the heart is altered from changes in the form of the adjacent viscera, or that its bulk is altered, by which changes there is an alteration in the seat of the sounds.

Changes in their extent.

In *extent* the sounds may be circumscribed and limited to the præcordial region; or they may be recognised over more or less of the thorax. When the walls of the heart have become thinner and softer than natural, and when the muscular portion of the heart has lost its power, the sounds are extremely feeble, and sometimes become almost inaudible. But when the heart's vigour is increased, which takes place from a violent muscular exertion or moral excitement, there is then a corresponding increase in the extent to which the sounds are heard; and likewise when, from any mechanical impediment to the passage of the blood through the cavities of the heart, the sounds are recognised over a larger extent of the thorax.

Changes in their intensity.

The diminution and the increase in the *intensity* of the sounds, and the extent to which they are heard, correspond exactly; so that, whilst in some states of the heart the sounds are so feeble as not to be audible, in other examples of disease the heart beats with such force that they are heard over the whole chest, and are so intense, as even to be perceptible to an observer. The sounds, too, become louder and clearer when the parietes are thinnest, and the cavities of the heart are preternaturally dilated; the fluid blood being a much better conductor of the sound than the solid walls of the ventricles.

Changes in their regularity.

In their *regularity* the sounds are often changed, and these changes accord with those which are characteristic of the *intermittent* pulse; in the same manner as the beats of the heart, by varying in their force, are not always sufficiently strong to cause a corresponding pulsation in the radial artery, we find also that the sounds are not always perceptible.

Hence, from the same causes, we have irregularities in both the cardiac and radial pulse, as also changes in the order and in the duration of the sounds: all which are generally produced by structural changes in the apparatus of the central organ.

Changes in their number.

In *number* the sounds of the heart also vary. In some diseases, only one of the sounds can be recognised. This may arise either from the first sound being so much prolonged, or so changed, as to obscure the second, or from the second sound being so feeble as not to be distinguishable.

In diseases, as those where there is a contraction of the auriculo-ventricular orifices, *new* sounds are superadded; so that, in some instances, there are three or four distinct sounds which have been discriminated, at each beat of the heart.

Bouillaud.

Changes in their tone.

As the varieties of the sounds are caused by changes in the currents of the blood, we naturally expect to find that their *tone* will also be variously modified, just as the tone of the sounds of the respiratory organs is altered by changes in the velocity of the currents of the air, when passing through the bronchi, trachea, and larynx.

In diseases of the heart the sounds are sometimes *sharper*, or sometimes *duller*, than natural. In estimating these differences, it is necessary to consider, whether the sound be conveyed to the organ of hearing by a wooden or by a metallic instrument, or by the naked ear, as the tone is different in each; for, if the sound be conducted by an instrument which doubles the velocity of the sound, the *tone* will then be one octave higher.

Accordance with pulse, heart's impulse, and sounds.

There is no more important point of consideration than the accordance in the cardiac and arterial pulses, in the impulse, and in the sounds of the heart.

In one class of cases, as in inflammatory diseases, we find that there is a correspondence or unity in all these four symptoms—the vigour and frequency of both the cardiac and arterial pulse being increased, as well as the intensity of the impulse and of the sounds.

In another class of cases, the changes in these signs by no means correspond. Thus, where there is a mechanical obstruction to the transit of the blood within the heart, the impulse may then be increased, and the vigour of the arterial pulse diminished. When there is an obstruction through the aortic valves, the impulse may be feeble and the sounds louder.

Sounds perceptible to the patient.

There are, likewise, sounds of the heart which have been heard by the patients themselves. In a case of diseased mitral valve, the patient was annoyed, at night, when in bed, by a sound which he supposed to be a dog barking at a neighbouring farmhouse.

Sounds of blowing.

The bellows sound, or that of *blowing*, under which term a variety of modifications of the sounds have been comprehended, such as sawing, filing, grating, whizzing, and whistling, is the most frequent. These various sounds arise from the infinite variety of the currents of the blood in its passage through the heart's cavities, in consequence of disease of the valves or of different portions of the interior membrane of the heart.

We must not, however, conclude that these sounds are only to be heard when there is an obstruction in the valvular apparatus; neither must we conclude that such an obstruction is always accompanied by such sounds. These sounds are often met with not only when there are no diseased changes in the structure of the heart, but when changes have taken place in the quantity or in the quality of the blood, as in cases where there has been a profuse hæmorrhage, in chlorosis, in jaundice, and in rheumatism. On the other hand, obstructions to the blood's currents, from structural changes of the heart, have been found after death, though no morbid sounds had been detected during life.

Sounds of friction.

There are sounds, which are formed externally to the heart, which are supposed to be caused by changes in the structure of the pericardium. To distinguish these from those of blowing, or from those produced by changes in the blood's currents, they have been denominated the sounds of *friction.*

The office of the pericardium being not only by its connexion with the mediastinum and the diaphragm, to suspend the heart and prevent its displacement during its unceasing movements, but also to facilitate its motions upon the adjacent parts by its smooth and moistened surfaces, whenever it undergoes any change, such as frequently happens from the effusion of lymph upon its surface or its ossification, the friction of the two rugged or unequal surfaces against one another has been supposed to create sounds, as rustling, crackling, rasping, or emitting a sound like that produced by new leather.

Subject concluded.

In concluding these observations on the sounds of the heart, I may repeat that, as within the sac of a *true* aneurism there is a distinct whizzing noise, produced by the blood's stream passing from the canal of the artery into the aneurismal sac; and as that sound is changed in the *varicose* aneurism, where there are two distinct streams of blood, one passing into the aneurismal sac, and the other passing from the sac into the vein, it, therefore, appears to me legitimate to conclude, that both the natural and the diseased sounds of the heart may all be referable to particular changes either in the heart's structure or functions, and by which alterations are produced in the currents of the blood.

Admitting that one of the audible sounds of the heart is produced by the current of the blood passing from the auricles into the ventricles, and the other sound by the stream passing from the ventricles into the great arterial trunks, these being probably the two largest and most rapid streams within the heart, how varied must these sounds be, when only a portion of the apparatus, and how much more varied will they not be, when several portions of the complicated forms of the heart's cavities are changed by disease! Under such circumstances we cannot well suppose that the multiplied currents of the blood should produce sounds each of which can be distinguished by the human ear.

Unphilosophical theories of the causes of the sounds.

As to the absurd *theories* which pretend to explain the causes of the sounds of the heart, I must refer the reader to the works which have been published upon that subject, where he will find that "the results of physiological inquiries have not been in proportion to the number of authors who have written upon the subject; on the contrary, you are disturbed by contradictions of the most glaring nature, or bewildered between a mass of theories and explanations which have no existence but in the minds of the inventors." I may also quote the result of the patient investigations of Barth and Roger, and refer to their works for a lengthened account of the absurd theories that have been set forth. "So many works have been published on this subject that science is really encumbered by them, and through the mist of opposite theories and contradictory facts the observer is scarcely regaled by a single beam of truth."

Magendie.

Barth and Roger on *Auscultation.* Translated by Newbigging.

This appears to me a fit opportunity to caution the younger members of the medical profession against the practice of endeavouring to explain the phenomena of the human economy by making experiments on *living* animals. The opinions and sentiments which I entertain upon this subject have been so well expressed by Macilwain, in his eloquent address to the "Society for Preventing Cruelty to Animals," that I am induced to quote his own words:—

"Many medical men already view vivisection, as a mode of physiological inquiry, with distrust; many are already convinced that it is useless and fallacious; I would fain believe that all view it as a plague-spot on a beautiful science which, in its most amiable and useful applications to their brother men, may be regarded as especially their own." And again he adds:—"The progress of science holds out little promise from any elaborate 'torturing of nature,' much less by that of sentient beings, since the most profound discoveries hitherto achieved have not resulted from the invention of artificial or even new facts, but from a careful study of the true relations of those which have always been matters of daily and familiar occurrence."[1]

The Use and Abuse of the Stethoscope.

The sounds to be perceived by the stethoscope,

The sounds of the heart may be discriminated either by placing the external ear on the solid walls of the chest, or by the intervention of the *stethoscope*, an instrument employed by Laennec, for the purpose of conveying to the ear the sounds of the heart. But, however well adapted the stethoscope may be to some observers for distinguishing the sounds, others prefer the naked ear placed directly upon the chest. The contact of the extremity of the stethoscope is irksome to the ear of some people, and confuses the organ. The formality of making use of such an instrument often alarms the patient—a circumstance which ought on all occasions to be avoided, especially with those who are suspected to have a disease of the heart. The stethoscope, however, may be applicable to the examination of the chests of women, and of patients in public hospitals, and likewise of those

or the naked ear.

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[1] *Remarks on Vivisection*, &c. &c. &c. By George Macilwain, Esq. 1847.

classes of society where due attention is not always paid to personal cleanliness.

Imperfection of Laennec's stethoscope.

In regard to the construction of the stethoscope, I may briefly notice, that an instrument made of a hollow wooden cylinder, with a column of air admitted through it, such as was recommended by Laennec, is not calculated to fulfil the purpose for which it is intended. Acoustic experiments have shown that wood is not a good conductor of sound; and a column of air is a much worse conductor than wood: therefore, the supposed condensation of the air, and the increased intensity of the sound produced by the trumpet-shaped mouth of Laennec's instrument are fallacious. A stethoscope made of solid wood is, therefore, preferable to the hollow instrument.

how to be remedied.

But if it be as desirable to *increase* the intensity of a sound, as it is to increase the bulk of an object by viewing it through a lens, this may be accomplished by making the instrument of a material known to be a good conductor of sound, such as cast-iron, steel, copper, or silver.[1]

Such an instrument is surely preferable to the practice which has been recommended of employing artificial means to increase the action of the heart itself. "Those who are suspected to have an affection of the heart are directed to walk rapidly, or to go quickly up stairs, by which they accelerate the circulation, and thus exaggerate, if not develop, phenomena which would have escaped notice, or would not otherwise have existed." Newbigging.

The *iron* stethoscope should consist of a solid iron stem, three-quarters of an inch in diameter, and six or eight inches in length, one end of which is to be rounded off and made slightly conical or "nipple-shaped," so as to rest only upon the edge of

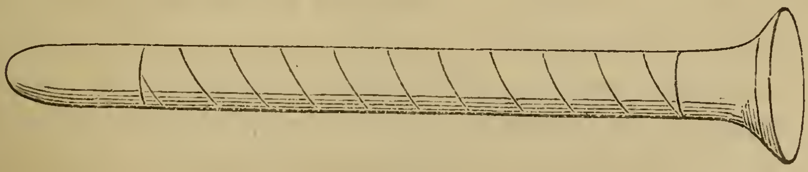

Fig. 26.

Fig. 26.

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[1] "Iron conveys sound seventeen times faster than air."—"Gutta-percha is one of the best materials for the tubular conveyance of sound."—Hogg.

the external meatus, whilst its other extremity is expanded so as to cover a surface of the chest of an inch and a half. The elastic nature of the iron enables it not only to convey a current of sound, but to increase its intensity—a physical fact familiarly known in the practice of ascertaining the boiling of water in a kettle by applying one end of an iron rod or a poker to the kettle and the other to the external ear; and also from the common experiment of suspending by a cord, a poker, or iron rod, which is placed in contact with the ear, when the rod is struck with a piece of metal, the slightest blow produces a sound of almost incredible intensity.

So much has been said, both in favour and condemnatory of auscultation, that to determine the real value of the physical means of exploring the diseases of the heart is a matter of grave importance.

It is impossible to discuss with candour this subject without displeasing, more or less, either its advocates or its opponents; it would be just as difficult to find out the unsuccessful result of auscultation as of the good and hurtful effects of many medicines, or of the true result of surgical operations.

The most impartial mode of deciding this question is to embrace opportunities of watching the results of the diagnosis made by those who do and by those who do not rely on auscultation. It would be unjust to take our own experience alone, for there cannot be a doubt but that all have not the same power of discriminating the sounds of the heart in all their different phases. By practice the sense of hearing may, no doubt, be greatly improved; but I am well persuaded that, as the eye in many persons can by no tuition be improved in its power of discriminating the nicer varieties in form and in colour, so it is with the ear; as there are many who cannot distinguish the slighter differences in the intensity of sounds, and who are also quite incapable of perceiving the differences of tones, from the want of a musical ear.

From the numerous observations which I have been enabled to make on the opinions and practice of others, I must confess that very many instances of serious mistakes have arisen from confiding solely to a stethoscopic examination. Having been engaged in the practice of my profession, long before auscultation was employed, I am bound to say, that whatever advantages may be derived from auscultation, when judiciously resorted to, and combined with a careful inquiry into all the assemblages of the general symptoms, yet that, in consequence of most of those who profess to have acquired dexterity in using it, neglecting to investigate the physiological symptoms, more errors in diagnosis have come within my own knowledge than in former times were committed by those whose attention was solely directed both to the local and to the general symptoms.

I have also had many opportunities of testing the accuracy of stethoscopic investigations after the disease had terminated. I must confess that I have become acquainted with many, I may truly say very many, serious mistakes. Above all, opinions so perfectly opposite, have been given in cases of organic changes of the heart, by those who were well accustomed to the use of the stethoscope, that I have come to the conclusion that its practical utility is very limited; that the information derived from it ought to be received with much caution; and, above all, that such information, in place of superseding, ought merely to be *superadded* to that which is to be acquired by a careful examination of the physiological symptoms and the history of the disease.

The objections to stethoscopic investigations may be greatly removed by considering the time and the circumstances under which they are made; and in order to avoid any erroneous impressions which may arise from them, it is judicious in every case, first, carefully to examine all the physiological symptoms, and also to acquire an accurate knowledge of the origin and progress of the disease. Whatever auscultation may afterwards reveal may then be duly appreciated; and, if we are previously satisfied with the accuracy of the diagnosis and of the principles of treatment that ought to be adopted, no stethoscopic information that can be afterwards obtained, even if not useful in confirming that opinion, can be prejudicial in the treatment of the case.

Notwithstanding all that may be said against auscultation, we ought not, therefore, to disregard the utility of the information to be derived from it. It is true, that it may be of little practical advantage to know, in the advanced stage of disease of the heart, whether the valves of the auriculo-ventricular, or that the aortic orifice, or both, be changed; or whether the pericardium or endocardium, or both these membranes, be involved in a case of rheumatic or of arthritic inflammation. It may be said that there is no more advantage to be derived from such information, than would be obtained for the treatment of an inflammation of the internal ear, from being able to detect whether that inflammation existed in the vestibule, in the semicircular canals, or in the cochlea. It is, however, of vast consequence to ascertain the changes in the sounds and in the impulse of the heart, by which, along with the physiological symptoms, we can, with much certainty, discriminate functional from organic diseases.

The observations which I have now made on the stethoscopic signs of diseases of the heart are amply confirmed by the testimony of many distinguished authors, some of whom have given most decided opinions, and others incontrovertible evidence of the difficulties which they had experienced from the ambiguous language which they have employed when treating on the subject of diagnosis.

In the *Dictionary of Practical Medicine*, the learned author, when alluding to this subject, has observed that "no partial or empirical views should be entertained; and far less should a charlatan-parade of examination be pursued, to the neglect of *physiological* inquiry. There is as much empiricism at the present day in the modes of investigating diseases as in those of curing them; with this difference, that the empiricism of the former kind is much more *ad captandum* than the latter, and generally more fussy, and often more offensive."

I may likewise add the testimony of one highly qualified to appreciate the merits, and expose the fallacies of auscultation, and who was one of its earliest advocates.

"Though a warm advocate for ausculation, I am aware that, besides the injurious and absurd affectation of pretending to understand it by some who are really particularly ignorant of it, there are others who place too much reliance on it for diagnosis, without considering the collateral constitutional symptoms."

Billing's *First Principles of Medicine.*

Symptoms derived from the Percussion of the Chest.

The utility of percussion.

Though *percussion*, as a means of diagnosis in diseases of the chest, had not been methodically resorted to until Avenbrugger published a work upon the subject, and not till its utility was brought into general notice in France by Corvisart, and in this country by a translation and commentaries by Forbes,[1] it had nevertheless been frequently employed, and often, too, for the investigation of the diseases of other organs besides those of the chest, and had always been considered a useful auxiliary for determining the nature of the contents of tumours, whether solid or fluid.

"Amongst the means calculated to point out the diseases of the central organ of the circulation, we ought to give a distinguished place to the *percussion* of the chest. This method, of which I have made a successful application in a great number of cases, has afforded me great assistance in practice whenever I was desirous of being assured of the sound, or of the diseased state of the organs of circulation. Such, indeed, is the degree of its precision that often I have been able to determine with accuracy, what was proved by the inspection of the body after death." Corvisart.

In the region of the heart the sound elicited by percussion is a dead sound, such as that produced on a fleshy limb; whereas all the other portions of the chest, being filled with air, give a hollow sound.

"The sound elicited by percussion from the healthy chest resembles the stifled sound of a drum covered with a thick woollen cloth." Avenbrugger.

As was observed, when speaking of the necessity of tutoring the organ of hearing to enable us to distinguish the more minute sounds, the same tuition is necessary to enable us to perceive the different sounds which are elicited by percussion.

"Practice alone teaches us to know the degree of resonance which a chest denotes in which the organs contained in it have not been changed, as it is the solidity of a body which causes the chest not to resound. But, in forming an opinion of the degree of the resonance, one ought to be careful to consider the

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[1] *On the Use of the Stethoscope and Percussion.* By John Forbes, Esq., M.D. London, 1824.

Corvisart. natural thickness of the integuments, and the frequency of their infiltration, as these may prevent the resonance when there is no other cause for it."

Wills. In percussing the chest, it is usual to place one hand firmly on the chest, and by tapping the back of it with the points of the fingers of the other hand, the sound is readily elicited; or, in place of the hand, a solid substance may be employed; a piece of Indian-rubber, about an inch square and a quarter of an inch in thickness, forms one of the best plessimeters.

The advantage derived from giving a blow upon a large and non-conducting substance is, that such a substance retains for a more lengthened period than a solid or very dense substance, such as ivory would do, the impulse given by the blow.

Symptoms elicited by Touch.

Increased sensibility. An increase of sensibility is an indication of a disorder of the heart, which ought not to be disregarded. I have frequently found persons who were suffering from all the symptoms of congestion in the heart complain of more or less tenderness on pressure upon the cardiac region; the feeling of uneasiness or pain thus created, is often accompanied by a sob and a difficulty in breathing.

Heartache. Heartache, like heart-sickness, is a common but a perfectly correct expression; and those who have had the heart much excited from affliction often have a fixed pain, as well as an increased uneasiness from pressure, in the cardiac region.

In inflammatory affections of the chest, the degree of the inflammation is usually tested by the pain produced by a full inspiration, or by the effect of coughing; the pain in such cases being caused by moving and altering the position of the diseased parts. If the inspirations be very limited, as in pulmo-cardiac congestion, and the patient be unable to distend the chest, the effort does not create local pain, but there is merely an inability to expand the lungs fully from the inordinate congestion of the pulmonary vessels.

Symptoms derived from Differences in the Form of the Chest.

The form of the chest deserves great attention in the diagnosis of affections of the heart. It is a general remark, that those who have diseased lungs, or who are predisposed to pulmonary affections have the capacity of the thorax small. Now, I have almost invariably observed that it is precisely the reverse in those who have disordered hearts; and if I could venture to lay down any general rule on this point, I should say that in those who are affected with, or who are predisposed to diseases of the heart, the chest is generally full and well developed.

Symptoms derived from Changes of Posture.

"All the positions which patients attacked with organic affections of the heart can take in bed are not equally favourable to respiration. It is indifferent to him whether he lie on the left or the right side; most usually he can respire with least difficulty whilst sitting; he inclines the body backwards, and bends the trunk so as to throw the anterior part of the chest forward. It is in consequence of this forced attitude that he experiences a relief to enable him to sleep. This position, however, is not the only one which is favourable to respiration; and often the individual affected with a similar disease takes a position almost the reverse, which is no less favourable to him; he rests inclined forwards, the abdomen in contact with the thighs, and the chest close to the knees. I have seen patients preserve this position for many successive days, because it is one which renders their condition supportable." Corvisart.

CHAPTER XXV.

THE DIAGNOSIS OF THE DISEASES OF THE HEART.

General observations; the physiological symptoms are common to the diseases of several organs; the anatomical symptoms appertain to the diseases of the heart alone; importance of a knowledge of the history of diseases; and of their first symptoms; and in the different classes of society; the effect of medicines to be discriminated from symptoms; diagnostic symptoms derived from the diseases of the cerebro-spinal system; diagnostic symptoms derived from the diseases of the respiratory system; symptoms common to these systems and the heart; both systems frequently implicated; these combinations enumerated; diagnostic symptoms derived from the diseases of digestive system; diagnostic symptoms derived from the diseases of the vascular system; diagnosis of aneurism at the root of the aorta and its large vessels; diagnosis of the venous system; anatomical symptoms.

The importance of diagnosis.

The diagnosis of diseases may be considered as the stepping-stone to their treatment. The common remark, that "if a disease be accurately discriminated, it may be considered as half cured," is perfectly correct. When the whole assemblage of symptoms have been strictly analysed—the condition of the different systems of the economy distinctly made out—the symptoms which belong to the primary disease discriminated from those of other systems which are affected—the history of the disease ascertained,—then, and not until then, may the remedial means be selected, and with confidence administered.

The diseases of the heart to be distinguished from those of other organs;

Although I have enumerated and endeavoured to explain various *symptoms*, both anatomical and physiological—local and general, which accompany disorders of the heart, it must not, however, be concluded that all these symptoms appertain to the heart's diseases alone, or that all of them belong to any one of its diseases. By an examination of the general or physiological symptoms, we shall find that many of these symptoms are com-

and from one another.

mon to diseases of other organs as well as to those of the heart; neither can it be supposed, that, in the extensive catalogue of the anatomical symptoms, all of them are manifested in each of the heart's maladies. It is, therefore, necessary, in treating of the diagnosis of these diseases, not only to discriminate them from those of other organs, but also to distinguish them from each other. Hence the difficulties as well as the importance of their diagnosis.

In considering this subject, let us first inquire into those symptoms by which the diseases of the heart may be distinguished from the diseases of other organs and systems of the economy; and afterwards investigate those symptoms, by which the particular diseases of the heart may be distinguished from each other.

To be able to discriminate the diseases of the heart from those of other organs, it is requisite that we should not only possess a comprehensive knowledge of their anatomical and physiological symptoms; but that we should also be well acquainted with the symptoms of the diseases of all the other systems of the economy. As these symptoms are derived from the different systems, in consequence of some change in the supply of their blood, it will happen that, in the idiopathic affections of these systems, the functions of the heart will be more or less influenced. Consequently, the physiological symptoms derived from the different systems will likewise be met with, independently of any disease of the heart.

We may readily conceive, that if one portion of the structure of the heart be changed, the functions of that part alone will not be affected, but that the functions of all the others will be more or less deranged. Hence arise the numerous complications of the symptoms of the diseases of the heart, the difficulty, indeed sometimes the impossibility, of accurately distinguishing them from each other, especially in their advanced stages, when morbid alterations have taken place in several portions of the heart's tissues.

In order to form a correct diagnosis of the diseases of the heart, it is therefore prudent never to presume to give an opinion in any case from examining the heart alone, or from the symptoms which may be indicated by the disturbance of any particular organ or system of organs; but always to investigate in succession all the systems of the economy, as well as the local or anatomical symptoms, and to view the assemblage of symptoms as one whole.

A knowledge of the history of diseases essential.

There is nothing that enables us better to form a correct diagnosis than the *history* of the disease: when acquainted with the first symptoms, tracing their progress, and the gradual implication of other organs, we can then, in most instances, discover the organ that has been primarily affected.

Next in importance to discriminating the diseases of the heart from those of other organs, is to be able to distinguish its particular diseases from each other; this can only be successfully accomplished by a familiar acquaintance with the phenomena and causes of each disease.

And to detect the first symptoms of disease.

The advantages which may be derived from detecting disease in its earliest stage, and at this period to be enabled to employ the proper curative means, is a matter of great importance in the practice of the healing art. The most serious diseases usually commence with no very alarming symptoms, and are attended with little suffering; and yet these early symptoms may be quite as characteristic of the disease as those which are manifested after it is far advanced.

And to discriminate the peculiarities of each case.

Next to the advantages of distinguishing diseases at an early period of their.progress, is the being able to discriminate the peculiarities of each case; for it is with the heart, as with all other organs, that two examples of the same disease are seldom met with which are in every respect similar.

"Indeed, every physician sees some difficulties in almost every case that comes under his care; and the superiority of one practitioner over another consists in his power of discriminating, with more or less accuracy, the peculiarities of each case, and of adapting his remedies to each individual."

Barlow, *Ed. Med. and Ch. Journal.*

The differences of the heart's diseases in different classes of people.

It is also essential, when investigating the diseases of the heart, and comparing the writings of different authors, carefully to consider the class, habits, and pursuits of those persons on whom the observations have been made, as there is often a very great difference in the general character of the same disease in different persons, as well as in different classes of the community. If one class of our fellow-beings are deprived, not only of the luxuries, but even of the comforts of life, they are exempt from many of the ailments to which the wealthy and luxurious, and also those whose occupation exposes them to much mental excitement, are subject. In hospitals, and amongst the poorer classes of society, diseases of the heart seldom come under observation, until they have arrived at an advanced stage; and there are some of its disorders which one seldom meets with in those institutions.

Minute diagnosis, how to be appreciated.

However numerous may have been the errors, and how little may be the practical benefit which has hitherto resulted from attempting a minute diagnosis of the morbid changes of the particular portions of the heart's structure, yet many facts which now appear isolated and unimportant, may at some future period be linked together and materially advance the progress of the healing art. "The history of every science shows, that, generally speaking, every addition of knowledge has been an increase of power; and innumerable discoveries could be mentioned which, at the time they were made, seemed of no value, but which eventually proved of the greatest importance." Forbes.

There is no better evidence of there being a primary disease existing in the heart, than the *absence* of all symptoms of disease in the digestive, respiratory, and nervous systems. When, therefore, we find, in any case, that the functions of the heart are disturbed, and that there is no derangement in any of the other organs, the existence of some organic affection of the heart may then be suspected.

The diagnosis in doubtful cases.

But whenever there is any doubt as to the existence of organic disease, it is prudent always to act as if the case was one purely functional; for, besides the influence that a sanguine opinion might have on the mind of the sufferer, it gives more confidence in adopting any system of treatment calculated to relieve the symptoms. On the other hand, it will be generally found, that whenever organic changes in the heart do exist, they present some marked symptoms, which can seldom leave a doubt of their real nature.

The *permanency* and the *periodicity* of the symptoms are important diagnostic characters. In disturbances of the functions of the heart from changes in the blood, there is a permanent change in the circulation; whereas in the sympathetic affections of the heart the symptoms vary in severity, and sometimes altogether subside for a time.

Effects of medicines to be considered.

As there are so many medicinal substances which influence the action of the heart, care should always be taken, when examining its diseases, to become acquainted with the treatment under which the sufferer may be, at the time when the examination is made.

" The appearance or aspect of a disorder often varies according to the different methods of cure, some symptoms being rather occasioned by the physician than by the disorder itself: so that persons labouring under the same illness being differently treated have different symptoms. And hence, unless great caution be used in this point, our notions of the symptoms of diseases must necessarily be very loose and uncertain."

Sydenham.

Arrangement of the subject.

In considering the diagnosis of diseases of the heart, I will pursue the same order as has already been adopted when treating of their symptoms, reviewing in succession each of those systems of the economy, which are influenced by the functions of the heart, and from which the symptoms are derived.

The cerebro-spinal system.—We have seen how much the cerebro-spinal system is influenced by disturbances in the functions of the heart, and that a numerous class of symptoms in the heart's diseases are derived from the consent between these two organs. But we also find that similar symptoms may arise from diseases of other organs, as well as from those of the heart.

The nervous symptoms, which arise from a disturbance in the action of the heart, must be carefully distinguished from those symptoms which depend on a primary affection of the cerebro-spinal system. Indeed, there are no two classes of diseases more apt to be mistaken for one another; and no diseases which require more opposite systems of treatment.

Diseases of the digestive organs cause similar symptoms.

With the organs of *digestion* this frequently happens, as many morbid sensations in the brain and spinal cord arise from disorders of the alimentary canal, which appear so much alike in their characters to those caused by a disturbed heart, that their diagnosis is of great practical value.

Morbid sensations in the head.

When alluding to certain morbid sensations in the head caused by a disturbance in the heart, I mentioned that those sensations might be produced by a change in the proportions of the arterial and venous blood within the head; but, in estimating these sensations in the head as diagnostic symptoms of a disordered heart, they must be carefully distinguished from those sensations which are caused either by some primary affection of the encephalon, or, what is far more frequent, by a derangement in the digestive organs.

Watchfulness, mental irritability, &c. &c.

Watchfulness, mental irritability and aberration, coma, and dreaming, all which depend upon the condition of the cerebral circulation, and accompany disorders of the heart, may also arise either from morbid changes in the brain, or may be symptomatic of diseases of the digestive organs. The dizziness, the swimming in the head, the difficulty in balancing the body, the ringing in the ears, and the ocular spectra, all which I have pointed out as symptomatic of some affection of the heart, have also been often confounded with similar symptoms arising from diseases either of the digestive organs, or of the brain itself; but they can only be distinguished by a strict examination of the condition of the different organs in each particular case.

Moral depression.

Moral depression.—The peculiar state of mind which accompanies many of the disorders of the heart will be found a useful diagnostic symptom; and nothing is more characteristic of the heart being disturbed, than that persons who are, on other occasions, known not to be wanting in courage, express great apprehension of death. This state is very different from the condition of those sufferers who are afflicted with dyspepsia, and who are weary of their existence; and also from that of the furious maniac whose brain is diseased, and who is eager either to injure others, or to destroy himself.

Headache.

Headache.—There is no symptom the diagnosis of which is of more practical importance than headache. Headache as well as other morbid sensations in the head arising from a disordered heart, may be caused either by an increase or by a diminution in the proportion of the arterial blood within the head.

Different kinds of.

Unlike the uneasy feelings in the head, symptomatic of a disordered stomach, the headache arising from a disordered heart is of two very distinct kinds; one of them arising from an increase in the arterial, and the other from an increase in the venous blood within the head. These affections I have already fully explained.

From differences in the proportions of the blood;

Headache arising from an increase of arterial blood in the head is generally more or less permanent, varying in degree at different periods, but never ceasing altogether whilst the heart continues to be disturbed. Such headaches, I have already observed, are often accompanied by an irritable state of mind, and, in some instances, by even a temporary aberration of the intellectual powers.

The sensations in the head which are caused by a *diminution* in the proportion of the arterial blood in the brain may be readily distinguished from *plethora*, by examining the cardiac and radial pulses, as well as by other concomitant symptoms. In the one case, the heart's impulse may be strong, but the radial pulse small; whilst, in the other case, both the cardiac and the radial pulse will be vigorous.

and from digestive derangements;

The headaches which are symptomatic of digestive derangement, unlike the former, affect the sufferer at more or less distinct intervals. They are, at their commencement, very slight, and are circumscribed and limited to a portion of the head; advance gradually in severity, and often terminate in sickness and vomiting. These headaches are preceded by irregularities in the functions of the stomach and biliary organs, and by constipation; all which symptoms are aggravated by blood-letting, but are more or less relieved by alvine evacuations.

and from diseases of the encephalon;

The various uneasy feelings in the head, which are connected with the diseases of the encephalon and its adjacent structures, must also be carefully, and can generally be easily discriminated from those which are caused by a disordered heart. Nothing can be more characteristic of the pathological condition of the brain, than the increase, in place of the diminution, of these sensations in the head when local blood-letting is beneficially employed: hence blood-letting may be resorted to with discretion, even in doubtful cases, as a means of diagnosis. It will sometimes happen, that a person who has been long subject to headache, symptomatic of digestive derangement, will also suffer from a pain in the head, caused by plethora: the pain of the two headaches being of different characters. The utility of blood-letting, under such circumstances, was well exemplified in the case of the late Dr. Baillie. He was occasionally subject to "bilious" headaches. On one occasion he consulted me about

Case of Dr. Baillie.

some uneasy sensations in the head, which appeared to be of a different description, and which led me to advise him to apply a few leeches to the frontal vessels. To this he at first objected, observing that he had on several former occasions employed blood-letting, but that the effect had always been rather to increase than to diminish the headache. After some explanation of the difference in the cause of his present suffering, he was induced to apply leeches, which completely relieved him.

Difference in the effects of medicines.

In primary affections of the brain, accompanied by a disturbed circulation, it may be worthy of remark, that cardiac medicines are found to be useless; whilst, in primary affections of the heart, these remedies are equally efficacious.

Importance of the history of diseases.

But there is nothing which marks the distinction between idiopathic affections of the brain, and those which are symptomatic of a disordered heart, more correctly than the *history* of the disease; and to that, constant reference should be made in forming a diagnosis in the diseases of the two organs.

Diagnosis of fits.

Fits.—In those who are afflicted with *fits*, some disorder of the heart should always be suspected. At the same time, fits may be symptomatic of a disturbance of the digestive organs, or of a primary disease of the encephalon. In many cases of hysteria, epilepsy, and apoplexy, the primary seat of the disease has been found in the heart; and I have a strong impression, that by far the greater number of those headaches which are usually called *nervous*, are either symptomatic of a malady in the heart or in the digestive organs.

That some of these affections of the brain should be intimately connected with the state of the heart is illustrated by the striking fact of their paroxysms occurring only when the circulation is disturbed. In this there is a striking contrast to the *periodical* character of many other diseases.

Convulsions, two species of.

When speaking of *convulsions*, I pointed out that the involuntary actions of the muscles which accompany the different kinds of fits were employed by the economy for the purpose of restoring the balance of a disturbed circulation; the muscles during their contractions increasing the blood within the heart by impeding its flow through the compressed arteries. But though such convulsions are efforts of the *vis conservatrix*, it is of importance to be aware that convulsions also arise from other causes, and may be symptomatic of a primary disease or injury of the cerebro-spinal system; so that these two kinds of convulsions should be accurately discriminated, and each referred to that particular condition of which it is merely the symptom.

Syncope, different causes of.

Syncope, caused by organic disease of the heart, ought also to be carefully discriminated from that fainting state which is connected with diseases or injuries of the brain, and also from that which is caused by a deranged stomach.

The Spinal Cord.—When inquiring into the symptoms of diseases of the heart, which are derived from the cerebro-spinal system, it appeared that many of the changes in the functions of the spinal cord, as well as of the brain, were caused by changes in the functions of the heart, and that either the *sensory*, the *motor*, or both the columns of the spinal cord were affected by derangements of the circulation. At the same time, whilst investigating the diseases of the spinal cord, it must be kept in mind, that the functions of the spinal nerves are affected, not only in the diseases of those structures which surround the cord, but that they are also affected sympathetically.

Hamilton on Purgatives.

Examples of a sympathetic affection of the motor nerves are very remarkable in some cases of *chorea*, where that disease arises from a derangement in the alimentary canal; in cases of *trismus*, caused by an injury of the nervous system, and in other cases where the sensory column is the seat of neuralgic diseases.

The Respiratory System.—Next let us consider the diagnostic signs which are afforded by the *respiratory* system. From the still more intimate connexion of this system with the heart, the diagnosis becomes more intricate, and demands a closer scrutiny.

The diseases of the heart are more especially complicated with those of the lungs; they are, indeed, frequently mistaken for the affections of the lungs; and the diseases of the lungs are as often mistaken for those of the heart—an error of serious import in the practice of medicine; the more so, because the remedies which are most useful in the treatment of the one class of ailments, are either inefficacious, or they may even be injurious in those of the other.

Thus, the diagnosis of the various diseases of the three vital organs, the heart, the lungs, and the brain, opens a wide field for one of the most important and interesting inquiries in medical science.

For the same reason that the cerebro-spinal system is not affected in all the diseases of the heart, so we also find that, in all its diseases, the respiratory organs do not always appear to participate. At the same time, from there being a more intimate relation between the lungs and the heart than between the heart and the nervous system, we seldom find any considerable disturbance in the heart's functions without some change in the pulmonary circulation. It is through the medium of the lungs that the two hearts are linked together—the lungs being to the pulmonic and systemic hearts, what the capillaries are to the arteries and veins; the pulmonary vessels rendering the connexion between the lungs and heart as intimate, as the capillaries render that of the arterial and venous systems.

The instinctive acts of the economy performed by the respiratory organs conjointly with those of the heart, are all caused by a deranged circulation. As they are symptoms which do not occur in primary affections of the lungs, they afford an important addition to the diagnostic symptoms of diseases of the heart.

We have seen, that there is no more remarkable character of a disordered heart than changes in the frequency, in the regularity, and in the intensity of the breathing.

The breathing becomes very frequent, both in diseases of the lungs and of the heart; but when respiration is diminished below the natural standard, it is then probable that there is some disorder in the heart.

The same remark applies to the regularity or to the proportions of the inspirations and expirations—irregularities in these indicating some derangement in the heart's functions. Hence dyspnœa and asthma are, in many instances, caused by a disordered circulation—an important pathological fact first pointed out by Corvisart.

In diseases of the heart, respiration often becomes extremely languid, of which I have already cited several examples. This is a condition of respiration which does not accompany disease of the lungs, but arises from a disorder in the heart.

That the derangement of the respiratory organs, to which I have alluded, may be considered as characteristic of a disordered heart, is further confirmed, by the manifest difference of those changes which take place in the respiration when there is a primary disease in the lungs. Respiration, in diseases of the lungs, as in pulmonary phthisis, is merely quickened, and its rapidity is in proportion to the bulk of the portion of the lung which is incapable of receiving air; whereas, in diseases of the heart, respiration is irregular, and more or less tumultuous, being altered by every change in the circulation of the thoracic blood.

Cough, I have already explained at some length, may be symptomatic of a disease of the heart, as well as of the lungs. This symptom has a very different character in the different affections of the thoracic viscera. The circumstance that diseases of the heart are accompanied by cough and disturbed respiration, has, in many cases, caused such diseases to be mistaken and treated as primary affections of the lungs. The rationale which I have given of the different classes of coughs, is of essential use in the diagnosis of diseases of the chest; as, although both may be combined in particular cases, at different periods of the disease, still it enables us to refer each kind of cough to an affection either of the lungs or of the heart.

When the functions of the lungs have been long and seriously interrupted by a disturbance of the circulation, diseased changes of another character may supervene; and it is by no means unusual to see examples of thoracic disease, in which the heart's action has been first disturbed, and afterwards the patient has been attacked with inflammation of the mucous membrane of the bronchi, which superadded to the disturbed heart creates an assemblage of symptoms, all of which are apt to be attributed to a diseased state of the lungs.

In such cases the affection of the lungs becomes, sooner or later, of a more serious character, and ultimately, if the disease of the heart make great progress, the mucous membrane of the bronchi will be materially affected, and the pleura, with the parenchyma of the lungs, may also suffer from the repeated attacks of inflammation.

Hæmoptysis may, like cough, be accompanied by affections of the heart, as well as by diseases of the lungs. The characters of spontaneous hæmorrhages I have already fully explained, observing, at the same time, how frequently a spitting of blood, from pulmo-cardiac congestion, is mistaken for a symptom of organic disease of the lungs.

The presence of pulmonary *apoplexy* is of consequence to determine, in so far as it points out that a disturbance had previously taken place in the pulmo-cardiac function. "Besides the history of the case, and the existing symptoms, the *percussion* of the chest may point out a portion of the lung, the respiration of which is absent,—the breathing will be shorter and more frequent than natural, according to the extent of the pulmonary hepatization,—and there will not of necessity be present any febrile symptoms." Corvisart.

Form and size of the chest.

Though diseases of the heart have often been mistaken for affections of the lungs, and diseases of the lungs for affections of the heart, there is one striking difference in those persons who are afflicted with diseases of these organs, which I have found to be almost universal. Those suffering from or who have a predisposition to disease of the lungs, have the chest of small dimensions, so that the lungs are proportionally small; whereas in those with a disordered heart, I have generally found that the cavity of the thorax is of full dimensions: so that the large capacity of the thorax, along with the other symptoms which have been enumerated, is of no small importance in the diagnosis of the diseases of the thoracic viscera.

The Digestive Organs.—To be acquainted with the state of the digestive apparatus is of essential use in assisting us to form a correct diagnosis in the disorders of the heart. As, on the one hand, so many disturbances of the circulation arise from a disorder of the digestive organs, and as the diseases originating in the heart have comparatively but little influence on them, in all cases of cardiac disease, where the digestive organs are much deranged, such a condition affords a strong presumptive proof that the affection of the heart is symptomatic of that derangement. On the other hand, when the action of the heart is disordered, and there is no derangement of the digestive apparatus, we may then suspect that there is some primary affection of the heart.

The relation of the stomach and the heart is of a very different character to that between the heart and the lungs. From the lungs co-operating with the heart in the great function of the circulation, the diseases of these two organs are often necessarily combined; but as the consent between the heart and stomach depends upon the nervous system, derangements of the stomach which disturb the heart, and those of the heart which disorder the stomach, are purely *sympathetic*.

Such cases of disturbance of the heart are numerous; and there is nothing more common than to find its functions more or less interrupted by the presence of noxious food, or by an accumulation of morbid secretions in the alimentary canal. It therefore happens, that no class of affections have so often been mistaken for those of a diseased heart, as those which are symptomatic of a derangement of the digestive apparatus.

The functions of the organs of digestion are comparatively little influenced by diseases of the heart, and in persons with organic diseases of the heart, the organs of digestion are most commonly in a healthy condition,—an observation of importance to be kept in mind, when considering the diagnostic symptoms of organic diseases of the heart. As, therefore, a deranged state of the digestive organs, or some disturbance in the nervous system, may produce sympathetic affections of the heart, so the *absence* of any derangement of either of these systems, when the heart's functions are disturbed, may be taken as a strong criterion that some local affection of the heart exists.

Vomiting and nausea.

Vomiting, I have observed, may occur in diseases of the heart, as well as in derangements of the stomach; but the vomiting which is symptomatic of a disturbed circulation is usually preceded by *nausea*, or there may be nausea without vomiting.

When vomiting takes place from derangement of the stomach, that derangement is also accompanied by other symptoms, being an act resorted to by the economy solely for the purpose of evacuating from the stomach its offensive contents, or, as sometimes happens, especially in the infant, when there is a simple *regurgitation* of any surplus quantity of milk.

Flatulency.

Among the disorders of the stomach, causing a disturbance of the circulation, I may also mention *flatulency*, which, from the relative position of the heart, stomach, and colon, interrupts more or less the movements of the heart.

Case of Laennec.

"Laennec, who died of a tubercular affection of his lungs, heard very distinctly, a few days before his death, the pulsations of his heart; and having ascertained that his stomach was distended with gas, he suspected that it was the cause; in which he was confirmed by the sounds of the heart ceasing after eructation."

No less remarkable are the effects of "excrementitious" matters collected in the alimentary canal, as they not only derange the functions of the heart, but sometimes cause such violent palpitations of the *aorta* as to lead that symptom to be mistaken for that of aneurism.

Baillie.

It is also of importance, when examining into the condition of the heart, to become acquainted with any peculiarity of food, or of any particular medicine that may have been taken, as many of these disturb the heart.

A vomiting of blood, and an intestinal *hæmorrhage*, are by no means unfrequent symptoms of a disordered heart, generally appearing in those suffering from affections of the right heart. In the majority of cases, where there is congestion of the pulmonic heart, there is also more or less congestion throughout the whole venous system—a congestion especially in the abdominal veins; so that the hæmorrhoidal flux may either be symptomatic of a disordered heart, or of some disease of the chylopoietic viscera.

The arterial pulse.

The Vascular System.—It has been already mentioned, that by a great nicety which may be acquired in the sense of *touch*, we can be able to distinguish a very considerable number of the modifications in the arterial pulse, by which different conditions of the heart are more or less distinctly indicated. It was likewise observed, that however important it might be to become familiarly acquainted with the changes to which the sounds of the heart are liable, the varieties of the arterial pulse are of still greater value; inasmuch as the number of these changes are infinitely greater than those of the sounds which the ear can distinguish;—that, in short, we can recognise, by means of the sense of touch, changes in the systemic circulation which cannot be detected from the audible sounds of the heart.

Changes in the sounds of the heart are generally perceptible only in the more formidable affections, or in its organic diseases;

whereas by an examination of the arterial pulse, an infinite variety of disturbances in the *functions*, as well as in the structure of the heart can be readily detected.

As the changes in the functions of the arteries indicate corresponding changes in the heart's action, a knowledge of these changes will materially assist us in forming a correct diagnosis.

An important practical inference may be drawn from the remarks that have been already made, which is, that when the action of the heart is increased, and there is a corresponding increase in the pulse, the heart will probably be then in a sound state; but if the action of the heart be increased, and there be no corresponding increase, but, on the contrary, a diminution in the vigour of the pulse, there will probably be some change in the heart's structure.

Diagnosis of aortic aneurism.

The diagnosis of an *aneurism* formed at the root of the aorta must always be difficult. When small, or even of a moderate bulk, it can neither be seen, felt, nor heard, and its existence can only be suspected from its history. In this stage of the disease, we must not expect to derive benefit from auscultation: a startling proof of which is exemplified in the case of the late Mr. Liston. The physical signs in his case, as recorded by several experienced stethoscopic observers, were so contradictory as to lead to erroneous opinions of the true nature of his malady, and thus prevent an appropriate system of treatment being employed.

When it acquires a certain size, the aneurismal tumour then interferes, more or less, with respiration and deglutition. By its pressure upon the trachea, it affects the breathing, and if it compress the recurrent nerve, deglutition becomes more or less difficult.

It is not until the swelling has become so large, as to ascend near the upper extremity of the sternum, that it can be perceived; and when large enough to be distinguished, its pulsatory character can be also felt, and its whizzing noise becomes audible.

Aneurism can, in almost every instance, be traced to some great and sudden exertion, to some unaccustomed muscular effort, or to some violent mental emotion; and, therefore, the *history* of the symptoms is of essential importance; as it affords the only means of suspecting the existence of an aneurism in its early stage. That all the symptoms are traceable to some cause; that the circulation is much disturbed, producing giddiness or syncope; and that the patient suffers severely from the shock—all these form additional evidence of the nature of the disease.

A varicose state of the *venous* system is a very common symptom of a disorder of the right heart; especially if the veins of the head, neck, and upper extremities are affected; for when the veins of the abdominal parietes and inferior extremities are alone varicose, a disease of one of the abdominal or pelvic viscera is indicated.

The Anatomical Symptoms.—We have seen that there are physiological symptoms, which are common to diseases of other organs besides those of the heart; but the local or *anatomical* symptoms are derived solely from a derangement in the functions, or from an alteration in the structure of the heart; so that it is by a knowledge of these symptoms that we can obtain accurate information of the particular diseases of the heart.

Whilst due attention to the physiological symptoms has not been given, when investigating the diseases of the heart, far too much value has been placed on the anatomical; and to this must be attributed one very frequent source of error in diagnosis. If such be the difficulties, and if of such magnitude the mistakes that are committed, even by the most experienced auscultators, how great, therefore, must be the value of other diagnostic means?

The physical signs have derived importance from their utility in pointing out the nature of some diseases of the heart in their advanced stages, and when medical treatment is comparatively of little avail; but in the early stages of these diseases physical signs are comparatively useless; as in the treatment of every case we ought to look to the condition of the system generally, and to the assemblage of all the symptoms, our attention ought not to be distracted, when adopting a plan of treatment, by attempting to distinguish any particular *portion* of the circulating apparatus which may be deranged.

CHAPTER XXVI.

THE PROGNOSIS OF THE DISEASES OF THE HEART.

Observation of Hippocrates; danger of diseases in vital organs; many of the diseases of the heart can be remedied; erroneous opinions of their danger; causes of their danger; efficacy of medical treatment; errors of auscultation; delicacy to be observed in giving opinions to the sick.

THE father of medicine has justly observed, "That physician who, upon the appearance of some certain signs in a disease, can tell his patient what he has hitherto suffered, and what will happen to him every day; and after having received information from him, he not only speaks further of those things he omitted before, but also lays down beforehand what will come to pass, 'tis he shall have the reputation of knowing perfectly the condition of the patient, and make him entirely resign himself to his management. And as it is not always in the power of the physician to save the lives of the sick, for that reason prognostics will be serviceable in some measure to secure him from reproach." Hippocrates.

Comparative danger of the diseases of the heart.

In estimating the danger of diseases, there is no point on which greater weight should be placed, than the importance of the function which the disturbed organ performs in the animal economy; and we may generally prognosticate that the same extent of disease in a vital organ is attended with far more danger than a malady of equal severity in a less important part of the body.

"The diseases which come from any part of the body that is considerable, are the most dangerous; for if the disease rest, that is to say lodge, in the place where it began, when a part that is of great importance suffers, the whole body must suffer." Hippocrates.

The heart being so essential to life, any of its diseases naturally cause more or less anxiety; and its functions being so much under the influence of the mind, the impression which a patient may entertain of the result of his sufferings must materially influence the progress and termination of the disease. Neither is it to be wondered, that those suffering from such diseases should be apt to augur unfavourably of their termination.

Many of the heart's diseases are remediable.

Essential, however, as the heart may be for the preservation of life, it is, nevertheless, subject to numerous ailments, which, although they may materially influence the comfort and happiness of those afflicted by them, are yet as much under the control of medical treatment as the diseases of any other organ, and many of them are not of a fatal character.

A very general opinion has prevailed, that, if a disease of the heart be organic, it must be incurable; whereas, it may be affirmed, that changes in the heart's tissues are just as much under the control of medical treatment as organic diseases of other organs. All diseases are less and less remediable according to their duration, and the progress they have made; but when they are within certain limits, many morbid changes in the different organs can be mitigated, if not cured.

The prognosis difficult;

There is no point on which I would venture to differ more from some preceding writers, than in the *prognosis* of the diseases of the heart; being convinced that there are no diseases of the vital organs, which are more under the influence of medical treatment, or which, when they cannot be subdued by art, are more lingering; and that many who have long had a disordered heart, have ultimately perished from a disease in some other organ. The lives of one class of sufferers have thus been protracted far beyond the most sanguine expectations; whilst, in another class, death has taken place, when the ailment was not considered to threaten immediate danger, or even to be of much importance. Indeed, reviewing a catalogue of the various disorders of the heart, it is remarkable to what an extent morbid changes are revealed by dissection, which during life had caused little disturbance; and we wonder how life, under such circumstances, could have been sustained. We ought, therefore, to be most cautious in forming a prognosis in diseases of the heart, even when we have been able to determine accurately the extent of the structural changes which have taken place.

It is not sufficient that a correct diagnosis of a disease has been made, in order to give a correct prognosis. A vast number of circumstances appertaining to each case must be taken into consideration; the whole assemblage of symptoms; the peculiarities in the temperament, in the constitution, and in the habits of the patient; the age, and, above all, the history of the disease, all modify the prognosis in every case.

and often erroneous.

Diseases of the heart require a most careful scrutiny of all the symptoms—the physiological as well as the anatomical; the serious errors that have been committed, and the evils resulting from a mistaken diagnosis, ought to teach the necessity of using the greatest caution in every case before pronouncing an opinion of the nature and the probable duration of the disease. Whenever there is any doubt, we should always be inclined to consider the ailment to be functional—an opinion not only essential to be impressed on the sufferer, but it also leads to rational means being adopted to mitigate any functional disturbance; and as such functional disturbances are often superadded to some structural change, the treatment of them becomes the more imperative.

Nothing is more worthy of observation, than the remarkable differences in the degree, in the rapidity of the progress, and in the duration of diseases in every organ. Neither the severity of the symptoms, nor the rapidity of their progress, are by any means a certain index of the ultimate result; nor is the duration of an ailment a certain index of its termination. These remarks are strictly applicable to the diseases of the heart; as there is, perhaps, no class of ailments wherein the prognosis has often been more erroneous.

Excepting in those instances where they are caused by some great mental excitement, or by violent bodily exertion, the diseases of the heart usually make a very slow progress; and hence in those who die suddenly from them, it is usually found, after death, that the malady was of a character which must have been of long duration.

The danger of diseases of the heart, how increased.

There are two circumstances, which may powerfully operate either in diminishing or increasing the danger of the heart's diseases.

One of these arises from a common opinion, that the ailments of the heart have generally advanced too far, before medical aid is afforded; and the other, that there has been a want of due care and attention during convalescence.

It is on the first appearance of the symptoms when medical treatment, judiciously employed, has such a powerful influence in subduing disease; and, if that moment be lost, changes may then quickly supervene, which may sow the seeds of some future disease; and, however much the symptoms are afterwards controlled, they are never completely subdued.

The want of that unceasing care, which is so necessary during convalescence from all diseases, is often the cause of much future mischief in those suffering from disorders of the heart; and unless the most perfect mental, as well as bodily tranquillity be preserved, until every element of disease appears to be eradicated, we may safely prognosticate that, sooner or later, there will be a relapse of all the symptoms, and the foundation laid of some permanent mischief.

Efficacy of medical treatment.

But, as has been observed, almost all the diseases of the heart are as much under the influence of medical treatment, especially in their early stages, as those of any other vital organ; and even in those cases where they have made much progress, the severe symptoms can often be greatly alleviated, and life prolonged, far beyond the most sanguine expectations.[1]

"A wise physician will consider whether a disease be curable, or whether or not the cure of it be not full of peril; if he find it to be such, let him resort to palliatives and alleviate the symptoms, without busying himself too much with a perfect cure; and many times, if the patient be indeed patient, that course will exceed all expectation."

Bacon.

Dangers of giving an erroneous prognosis.

There can be no more unpardonable conduct than to give to the patient a decided opinion of his disease being of a dangerous nature, and of confidently auguring its fatal termination. Such, indeed, are the narrow limits of human foresight, that all men of experience and attentive observation, are much more tardy in giving a decided opinion of the result of a disease than the inexperienced practitioner. How many examples of erroneous prognosis in the diseases of the heart do we not all meet with? and I am convinced, that nothing has contributed more to extend this humiliating catalogue, than the introduction of auscultation.

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[1] "Diseases of the heart," says Andral, "characterized by the most severe symptoms, are not always without resources. The attention of physicians cannot be too much called to facts of this kind. Complaints of the heart ought to be placed among those affections which, having carried patients as near as possible to the grave, may yet be so remedied as to permit of a long existence."

Injurious influence of auscultation.

The *stethoscope*, it has been remarked, is often employed, not only very unnecessarily, and at an injudicious moment, but even, I regret to say, for unworthy purposes. To arrest a patient's attention to his heart by the formal pedantry of a stethoscopic examination, cannot fail to excite more or less anxiety and alarm. Such excitement alone has a powerful influence on the heart's movements, not only in increasing any unnatural motions of that organ, but even leading the sick to suspect that he has some serious disease when none exists.

"A custom," justly observes a popular author, "has long prevailed among physicians, of prognosticating, as they call it, the patient's fate, or foretelling the issue of the disease. Vanity, no doubt, introduced this practice, and still supports it, in spite of common sense and the safety of mankind. I have known a physician barbarous enough to boast, that he pronounced more *sentences* than all his Majesty's judges. Would to God that such sentences were not often equally fatal! It may, indeed, be alleged, that the doctor does not often declare his opinion before the patient. So much the worse. A sensible patient had better hear what the doctor says, than learn it from the disconsolate looks, the watery eyes, and the broken whispers of those about him. It seldom happens, when the physician gives an unfavourable opinion, that it can be concealed from the patient; the very embarrassment which the friends and attendants show in disguising what he has said, is generally sufficient to disclose the truth. We do not see what right any man has to announce the death of another, especially if such a declaration has a chance to kill him. Mankind are indeed very fond of prying into future events, and seldom fail to solicit the physician for his opinion. A doubtful answer, however, or one that may tend rather to encourage the hopes of the sick, would surely be more proper. This conduct could hurt neither the patient nor the physician. Nothing tends more to destroy the credit of physic than those rash and unfeeling prognosticators, who, by the bye, are generally the most ignorant of the faculty. The mistakes which daily happen in this way, are so many standing proofs of human vanity and the weakness of science.

"We readily admit, that there are cases where the physician ought to give intimation of the patient's danger to some of his near connexions, though even this ought always to be done with the greatest delicacy and caution; but it never can be necessary, in any case, that the whole town and country should know, immediately after the doctor has made his first visit, *that he has no hopes of his patient's recovery*. Persons whose impertinent curiosity leads them to question the physician with regard to the fate of the patient, certainly deserve no other than an evasive answer.

"The vanity of foretelling the fate of the sick is not peculiar to the faculty; others follow their example, and those who think themselves wiser than their neighbours often do much hurt in this way. Humanity surely calls upon every one to comfort the sick, and not to add to their affliction by alarming their fears. A friend, or even a physician, may often do more good by a mild and sympathizing behaviour than by medicine, and should never neglect to administer that greatest of all cordials—hope.

"So far, however, is this from being generally attended to, that many make it their business to visit the sick, on purpose to whisper dismal stories in their ears; such may pass for sympathizing friends, but they ought rather to be considered as cruel and unprincipled enemies."

Buchan's *Domestic Medicine.*

CHAPTER XXVII.

THE TREATMENT OF THE DISEASES OF THE HEART.

The imperfect classification of medicines; no class has been assigned to cardiacs; cardiac medicines enumerated; table of cardiacs.

The treatment of the maladies of the heart is not the least important subject to be discussed in this work. The details offer a far more extensive field of inquiry than has usually been allotted to them; and yet they have never been investigated in a general or comprehensive manner, nor has there been any advancement made on this branch of *therapeutics*, at all commensurate with the progress of physiological and pathological science.

Imperfection of this branch of therapeutics.

Those who have written on particular diseases of the heart have pointed out what they may have considered to be the best modes of treating them, but almost all their observations apply chiefly to its organic affections; whereas it is in the *functional* disorders of the circulating apparatus that the treatment is so important and so decidedly beneficial. Indeed, I will endeavour to prove that many of the functional disturbances of the heart, recorded in medical works, though they may not have been considered as primary affections, yet, whenever such ailments have been relieved by medical treatment, the relief has been obtained by employing those very remedies which have a specific influence on the organs of circulation.

No class assigned to cardiacs.

It is remarkable, that in no work on therapeutics do we find even a *class* assigned to those remedial substances which act directly upon the heart. The significant term *cardiacs* has seldom been made use of, although the word *cordial* is employed in common language distinctly to denote such substances. In place of being arranged together, as those medicines are, which act on the nervous, digestive, and biliary systems, on the kidneys and on the skin, cardiacs will be found classed—some amongst the tonics, some amongst the narcotics, and some amongst the anti-spasmodics.

Value of such a classification.

It seems to be inexplicable, how so important a class of medicines as those which have a specific influence upon the heart, should not have, like those which act upon other and far less important organs, been grouped together and arranged under one class. A *class* of cardiac remedies might, therefore, be very properly formed; in which might be arranged the various vegetable, mineral, and animal substances, which have a specific action on the central organ of the circulation.

There seems never to have been any fixed principles employed for classifying medicinal substances. Some classes have been formed by selecting for each those substances which produce particular effects upon certain organs or systems of the economy, such as sudorifics and diuretics. In other classes, medicinal substances are brought together, because they are each supposed to have the same influence on particular diseases, such as anti-spasmodics, and diffusible and permanent stimulants. There are also many medicines which belong to several different classes; for the same medicine affects different organs. The effects of medicines are greatly modified, or entirely new effects are produced, when administered in different doses; opium and alcohol, in small doses, exhilarate, and, in larger quantities, cause depression; so that these substances are both stimulant and sedative. The preparations of iron act as tonics and as astringents, and these preparations are arranged in both these classes of the *materia medica.*

The numerous medicinal substances of which I have subjoined a Table, have been placed in different classes of the *materia medica;* consequently, it may readily be anticipated, that they have also an influence upon other organs, besides the heart and vascular system. The great difficulty in classifying these substances arises from the circumstance just mentioned, that the same medicine has perfectly different effects when administered in different doses.

It is of great importance, in viewing *cardiacs* as a class, to

Ch. XXVII. remember, that each of them has its peculiar mode of acting upon the organs of circulation; some of them increasing, and others diminishing the heart's vigour: there are others also which act upon the heart through the medium of the blood.

TABLE.

Antimonials.
Mercurials.
Lead.
Silver.
Zinc.
Copper.
Iodine.
Alum.
Ammonia.
Soda.
Potash.

Alcohol.
Ether.
Chloroform.
Iron.
Camphor.
Valerian.
Myrrh.
Assafœtida.
Galbanum.
Opium.
Hyoscyamus.

Tobacco.
Belladonna.
Lobelia.
Ipecacuanha
Digitalis.
Hellebore.
Elaterium.
Colchicum.
Musk.
Castor.

CHAPTER XXVIII.

THE DOCTRINE OF REMEDIES.

Processes employed by the animal economy to cure diseases; these processes are both mechanical and chemical; they are under the influence of the vital principle; examples of these processes in man and in animals; the intimate union between animals and vegetables; animals exhale and excrete the elements necessary for the life of vegetables; vegetables exhale and secrete the elements necessary for the life of animals; the processes employed by the economy for the cure of diseases can be imitated; a system of therapeutics founded on these natural processes; this system illustrated by the doctrine of Hippocrates and the elder pathologists; its utility in the treatment of the diseases of the heart.

Sydenham, alluding to the works of Hippocrates, observes, "He exhibited a genuine history of the operations of Nature in the diseases of mankind. His theory was no more than an exact description of Nature; it was highly reasonable that he should aim in his practice only at relieving diseased nature by all the means he could employ; and hence he required no more of art than to assist nature when she languished, and to check her when her efforts were too violent; and to accomplish these two ends by the steps and methods whereby she endeavours to expel the disorder. For this sagacious observer found that nature alone terminates distempers, and works a cure with the assistance of a few simple medicines, and sometimes without any medicine at all." Sydenham.

Before entering further upon the important subject of the treatment of diseases of the heart, it appeared to me that it would be expedient to give a general view of therapeutic science; and that, by having once established some general principles, by which the treatment of diseases should be conducted, these principles can afterwards be applied to the treatment of the particular diseases of the heart.

To fulfil this purpose, I will endeavour to show that the instinctive processes, which the animal economy has the power of performing, not only for preserving and restoring functions of the economy when they are disordered, but likewise for the cure of diseases, are a safe guide to follow in the administration of remedies; and above all, that, for the cure of diseases, it is wise to follow Nature,—to endeavour to aid and assist her in executing her functions, but never to interrupt her efforts. By admitting this as a great general principle for conducting the treatment of disease, we shall find that all therapeutic agents may be simply arranged, and rules for administering them be distinctly pointed out.

Let us, therefore, review in succession these different acts of the economy, after which we shall be prepared to enter upon the consideration of the means which we possess for *imitating* these natural processes, and for their application in the treatment of the diseases of the heart.

Powers of the economy to regulate the circulation.

As the animal economy possesses powers within itself to preserve, and to restore the integrity of its various functions, when they have been deranged; and as, from the changes which are constantly taking place in the distribution of the blood to the different organs, whether for performing the functions of nutrition, growth, or life; or from those changes which are constantly resulting from the habits of organized beings, it becomes necessary that the economy should have requisite means to enable it to preserve the due proportion of blood in the different organs. For, although the heart impels the blood into all the arteries with equal velocity, yet the circulation, we have seen, undergoes various changes before it reaches the capillary system; such changes being produced by different modes in the arrangement of the arteries, and by differences in their modes of distribution in the various organs.

Two kinds of these.

Of the instinctive processes by which the circulation is regulated, one class, it has been shown, is employed to free the heart from any extra quantity of blood, and another class to increase the quantity; the one relieving an oppressed, and the other invigorating a feeble heart;—these processes are performed by the respiratory and muscular systems—by the *pulmo-cardiac* and the *musculo-cardiac* functions, separately or combined.

The constant changes in the inspirations and expirations, the acts of sobbing, sighing, and crying, are each of them instinctive efforts resorted to for unloading a congested heart, such as that caused by grief; whereas, by convulsive movements, as laughing, or by the *musculo-cardiac* function increasing the quantity of blood within the heart, its action is invigorated, as in persons when recovering from syncope, the hysteric paroxysm, and from other fits; the violent convulsive movements in these diseases promote the flow of the venous blood into the right, and impede the exit of the arterial blood from the left heart.

One relieves congestion, and the other syncope

Whilst such movements are employed by the economy for the purpose of restoring disturbances in the circulation, we have also seen that *convulsions* also take place under other, and, indeed, very different circumstances—as from disease or injuries of the nervous centres, or of the nerves emanating from them. The almost incessant involuntary movements which form so remarkable a feature during *chorea*, and the permanent contraction of the organs of active motion in *trismus*, appear, as far as our present knowledge extends, rather to be the direct effects of disease, than acts of the economy resorted to for the purpose of restoring a disturbed circulation.

Involuntary movements from different causes.

The instinctive acts performed by the organs of respiration and circulation are employed, not only for the purpose of preserving the balance of the circulation, which our habits and necessities constantly derange, but they are also resorted to by the system in the more serious diseases of the heart in which the circulation has suffered some additional causes of disturbance.

In those disorders wherein the powers of the economy are not sufficient to restore the circulation, we then find that further means and processes are resorted to, which, since the very dawn of medical science, have been observed and accurately described, though they have received far too little consideration from modern pathologists: "that there is in the animal economy a power to obviate and correct, in a certain degree, everything not suited to the health of the economy, which has been properly named the *vis naturæ conservatrix et medicatrix.*"

Powers of the economy to cure disease.

Cullen.

Of these processes, one of the most remarkable is *spontaneous hæmorrhage*, a process of the economy by which an accumulation of blood, or plethora of a particular organ, is relieved, and

Spontaneous hæmorrhage, curative effects of, the natural state of its circulation restored. Thus, it is in this manner that a fulness of blood in the head is relieved by epistaxis, in the chest by hæmoptysis, and in the chylopoietic viscera by the hæmorrhoidal flux.

and likewise of spontaneous vomiting.

No less remarkable are the effects of *spontaneous vomiting*, another process of the economy which is resorted to in disturbances of the circulation, more especially in derangements of the *capillaries*, whether of those of the cutaneous or of the gastro pulmonary mucous system. The violent muscular movements which accompany the act of vomiting have so powerful an effect on the circulation, that the functions of the capillaries, however much they may have been interrupted, appear to be almost immediately restored by it; so that, in place of coldness of the cutaneous surface accompanying such disturbance of the capillaries, a copious perspiration ensues; after which, the balance of the circulation is completely restored.

Its curative effects,

and of nausea.

Intimately associated as the act of vomiting is with *nausea*, and though these two processes have effects upon the system which appear to be quite different, yet, as I have already explained, they may either occur separately, or they may be combined together, forming one act.

Nausea, like vomiting, may be observed in many diseases to be employed by the *vis medicatrix*, in order to change the state of the circulation.

Nausea, without vomiting, frequently accompanies a suppression of the menstrual flux, being then employed by the *vis medicatrix* for the purpose of regulating the circulation in the heart, which, in such cases, is more or less deranged. Thus, it is not unusual to meet with examples of painful or obstructed menstruation, which are preceded by a fit of vomiting; the vomiting ceasing whenever the flux makes its appearance.

The sickness and vomiting, so frequently the accompaniments, and which are important diagnostic symptoms of an *impregnated uterus*, are, in all probability, an effort of the economy to preserve the balance of the circulation which has been disturbed by the condition of the uterine system.

In *hooping-cough* there is no more favourable sign, and nothing alleviates the severity of the symptoms of that disease more, than spontaneous vomiting; and instances are by no means rare, of persons who have a disease of the stomach being in the habit, for a lengthened period, of vomiting after each meal.

The regurgitation of the food in the infant;

In the *infant* we also observe how the economy employs the act of vomiting solely for the purpose of relieving the stomach of superabundant milk, or pernicious food. Infants are frequently in the habit of vomiting some of the milk which they have sucked, when, from too great desire, the stomach had been overloaded; a habit which sometimes continues for a lengthened period, without the health of the child appearing to be impaired.

and in the glutton.

The same is told of the *glutton;* that animal, after over-distending his stomach, is said to be in the habit of pressing himself in a convenient situation, such as between the branches of a tree, and thus to disgorge the stomach, in order that he may be again ready for another repast!

Sea-sickness and cholera.

The vomitings which accompany *sea-sickness* and *cholera* are all acts of the economy for which some wise purpose must undoubtedly be intended.

Vomiting instinctively resorted to by animals.

So great, indeed, is the influence of the act of vomiting in relieving disease, that, in order to produce it, some animals, when unwell, are instinctively impelled to eat substances which cause vomiting; familiar examples of which may be observed in the *dog* and *cat*, they being in the habit of causing themselves to vomit by eating particular plants.

Such processes are mechanical.

All these means possessed by the animal economy to restore a disturbed circulation are, it may be observed, strictly *mechanical.* The movements of the parietes of the chest in respiration and in vomiting; the increase in the vigour of the heart by the influence of the *musculo-cardiac* function; and the increase or diminution in the velocity of the streams of blood passing out of, and coming into the heart are, doubtless, all mechanical processes.

Chemical processes also employed by the economy.

But the animal economy possesses likewise means by which it can modify and correct the *qualities of the fluids*, when these have been changed by disease; such processes are considered *chemical*, but they are under the immediate control of the *vital* principle. It is this vital principle, which constitutes that remarkable difference between the processes which are performed in the *chemical* and in the *vital* laboratories, or the differences between the processes of organized and inorganized bodies. What the nature of the vital principle or nervous power is, we know not, and, in the present state of physiological science, we must be satisfied with observing its laws, and their operations in the animal economy.

The vital principle regulates them.

The blood changed by them.

We may observe *chemico-vital* processes resorted to, when there is a disordered circulation from a change in the qualities of the *blood*. Morbid alterations in that fluid are corrected by processes, which are executed either by the digestive, by the respiratory, or by the cutaneous systems, conveying and mixing with the blood various matters which may have been taken into the stomach, or absorbed by the lungs, or by the skin.

Noxious matters may be removed from the blood by the organs of *excretion*. Profuse perspiration and diarrhœa, critical sweats and purgings, the formation of abscesses and eruptions, are all processes which are employed by the *vis medicatrix naturæ* for the relief, and for the cure of disease.

Instinctive acts employed for these purposes.

To enable the economy to perform some of the processes for restoring the healthy state of the blood, man, like other animals, is endowed with an *instinct*, by which he can make choice of such kinds of food and drinks, as contain the elementary substances which are necessary in the chemico-vital laboratory, and enable it to form such compounds as may be required for restoring the blood to a healthy state. This instinct prompts man to change his food when suffering from disease; and, however inconsistent or improper the food he then selects may appear, the choice is always beneficial, and never injurious.

Exemplified in the sick.

To allow the sick to obey their natural instincts is a useful practical maxim: when the most skilful practitioner cannot presume to dictate either the kind or the quantity of food or drink, the sick man can, with confidence, select for himself such as are most palatable and grateful. Hence, amongst the sick, there are some who prefer animal to vegetable food; some salted to fresh meats; some fermented liquors, and others wines; some acidulated drinks, and others give preference to plain water.

The powers of the economy exemplified in wounds.

These restorative powers possessed by the animal economy, are no less apparent, when a part of the body has been *wounded* or otherwise injured. If the soft parts have been divided, or if a bone has been broken, or an artery wounded; in all such accidents the restorative powers of Nature are strikingly illustrated. What can be more beautiful than the means she employs to heal a wound of the skin? First arresting the hæmorrhage, by plugging up with a coagulum of blood the mouths of the divided arteries; then hermetically sealing the surface of the wound with a covering of inspissated blood; and finally, repairing the injury by a process of granulation and cicatrization. And what can be a more striking illustration of the *vis medicatrix naturæ*, than the reunion of a fractured bone by the deposit of osseous matter around the fractured extremities?

Instincts are universal in the animal creation.

We may indeed observe, that not only in man, but throughout the whole animal kingdom, there is an instinct by which every race of living beings is enabled to select its proper food, and to avoid such as is hurtful. There is also an instinct which prompts animals, when they are suffering from disease, to change their food, and choose aliments which, when in health, they never partake of, and for which they may even have a repugnance. It is thus why wild animals crowd to the *salt* springs which abound in the interior of the vast continent of America; and the *deer* which inhabit the hills and the forests of this country repair, at particular seasons, to the sea-shore, in search of those plants which are strongly impregnated with salt, and also to drink the sea-water.

Examples of these.

In some *birds* there is a similar instinct, which impels them to swallow substances, such as small stones or pebbles, for the purpose of aiding their digestion: the same instinctive powers direct the common *fowl* in the "laying season" to search for *lime*, from which the shell of its egg is to be formed.

What can more strikingly corroborate the existence of these instinctive powers than what is told by the Egyptian physicians of the habit of the *hippopotamus*, if it be not a fiction? That inhabitant of the Nile is said to come out of the river on particular occasions, and striking his gigantic feet against the sharp point of a broken reed, to lacerate the skin, from which a bleeding followed, which he stopped, after it had been sufficiently copious, by plugging up the wound with mud!

"God has the same care of brutes, and has given them *instinct* in lieu of reason, of which they are destitute. But if this instinct be real, it should be greatly superior to reason. Hence it reveals to brutes directly those things which the other does not discover to men till after abundance of turnings and windings." Van Swieten.

Carbonic acid evolved by animals.

Oxygen exhaled by vegetables.

It has also been ordained, that the animal and vegetable kingdoms shall be mutually dependent upon each other for their subsistence; plants, for their nourishment, absorbing carbonic acid, being that portion of the atmospheric air which is thrown off by animals, and which is hurtful to animal life; and animals, for their subsistence, inhaling oxygen, being that portion of the air which is evolved by plants.

Similar interchange takes place between the two kingdoms in solid food; for whilst the animal lives upon plants, the excretions of the animal become food to the vegetable.

Reflections on the intimate union of the animal and vegetable kingdoms.

It is impossible to contemplate all these instinctive acts of the animal economy without being struck with the wisdom and design by which the phenomena both of the animal and vegetable kingdoms are intimately associated and inseparably connected with one another.

Willick on *Diet and Regimen.* 1809.

"All nature," observes an elegant author, "is united by indissoluble ties; every individual thing exists for the sake of another."

These processes of the economy to be imitated in the treatment of disease

From what has now been said it appears to me, that a general principle may be legitimately established for the administration of remedies, based upon the processes which we have seen are instinctively resorted to by the animal economy to restore functions that have been deranged, and to repair injuries; and that a rational system of *therapeutics* should consist in imitating these processes, and in endeavouring to expedite or assist, but never to interrupt, Nature's efforts.

In reviewing the various remedial means which are employed by the economy for the cure of disease, what can more forcibly illustrate this great therapeutic principle than the fact, that the effects of each of our remedial means are in strict imitation of one of those natural processes; therefore the success of the physician, in the administration of these remedies, will depend upon the sagacity which he displays in selecting them in the appropriate stages of the disease, and according to the peculiarities of each case?

Some of the curative means act mechanically.

Of these curative means, as of those processes possessed by the economy, some are *mechanical* and some are *chemical.*

By the first class, or by those which are in imitation of the mechanical processes of the economy, we can *increase* or diminish the quantity of the heart's blood. We can increase the blood within the heart by muscular exertions, by changes in respiration, or by artificially stemming the flow of the arterial blood in the extremities of the body by the tourniquet; and we can *diminish* the quantity of blood within the heart by blood-letting, by abstracting blood from one part of the body to another by the application of cupping-glasses or cupping-boots, or by causing vomiting or fainting by the use of internal medicines.

Others act chemically.

As to the other class of remedies, or those which act chemically, the *Materia Medica* furnishes examples of animal, vegetable, and mineral substances, which act *chemically* upon the fluids, by the exhibition of which we can produce purging, sweating, or an increased flow of urine. We have, likewise, the means of restoring the qualities of the blood, when these have been altered, by aliments and drinks, as well as by various medicinal substances when taken into the stomach, or absorbed by the lungs or by the skin.

The processes of the economy imitated;

Thus, we may infer that the chemico-vital processes employed by the animal economy for preserving and restoring health may be considered as rational and legitimate guides for the treatment of disease, and that we also possess agents by which such processes can be imitated.

In confirmation of these views, we have only to consider the sensible effects which are produced upon the body by different remedial means, and thus discover the signs with which we are furnished for their administration.

by artificial blood-letting;

What can be a more certain indication of the propriety of employing artificial *blood-letting*, than the uneasy sensations in the head which are symptoms of plethora, and which were on a previous occasion relieved by a spontaneous bleeding from the nose; or what can be a more certain indication of the propriety of abstracting blood, when there is a return of particular uneasy feelings in the chest, and disturbed respiration, symptoms of pulmo-cardiac congestion, which had on a former occasion been relieved by a copious hæmoptysis?—or, in fine, of the advantages of blood-letting, when there are symptoms indicating a certain condition of the chylopoietic viscera, which have been mitigated by the hæmorrhoidal flux?

The same remarks are applicable to those diseases which nature relieves by *vomiting*, by *perspiration*, by *purging*, by an *increased secretion of urine*, by the formation of an *abscess*, or by a *cutaneous eruption*.

by the use of emetics;

The effort of *vomiting*, which marks the presence of some noxious matter in the stomach, is not only a symptom which gives this information, but it points out the propriety of administering an emetic; a practical lesson, which has been handed down to us by the Father of Medicine, who made use of emetics in *cholera morbus*, "though in this distemper they had vomited too much already, yet in this case a vomiting was cured by a vomit."

(*Epidem.* lib. v.)

and by sudorifics;

Perspirations likewise relieve certain states of the system, hence an increased heat of the skin becomes an indication of the propriety of administering sudorifics.

and by purgatives;

So, also, *purging* may be a symptom which, along with some others, indicates that either the mucous membrane of the bowels is inflamed, or that the biliary and other secretions are altered: it therefore points out the propriety of administering such medicines as may mitigate the condition of the mucous membrane of the intestine, or improve the condition of the biliary and other morbid secretions.

and by artificial discharges.

Abscesses are well known to relieve certain states of the system, and to point out the use of setons and issues in similar ailments; *eruptions* are no less effective in relieving diseases, and point out the propriety of treating such conditions of the system by evacuating and alterative remedies.

Principles of therapeutics.

The view that has been now given of the great general principle that ought to guide us in the treatment of disease, unfolds an extensive and interesting field of research: any further observations which I have to offer on the subject, whilst they are more immediately applicable to the treatment of the diseases of the heart, are yet of that general character, that they equally apply to the diseases of the other organs and other systems of the economy, and will, I hope, tend to elucidate and simplify a branch of medical science which has hitherto been complicated, and is still, in many respects, very obscure.

This great therapeutic principle of Nature is in accordance with, and indeed is chiefly derived from, the doctrines of some of the elder pathologists; and if the phenomena of the animal economy which have been pointed out, admit of the explanation that has been given, the influence which mechanical, as well as chemical processes, exercise in disease, must also be granted, and therefore the propriety of placing in these classes of remedies all the means which are employed for the cure of diseases, must be admitted.

By adopting these views we shall find, that the various remedial agents, which are applicable to the treatment of the diseases of the heart, can be systematically arranged; and, indeed, I may also remark, that there is no system of the economy where this therapeutic principle can be so satisfactorily illustrated as in the organs of circulation.

Pathological doctrines of the schools.

In prosecuting our inquiries on this most important branch of medical science, it behoves us to glance over some of those systems of physic which have been taught in the "schools;" and I think it will appear that, although the doctrines of each system, contemplated as a whole, may be objectionable, yet materials may be gleaned from all of them by which essential aid may be obtained in forming a rational system of therapeutics.

"All physic," says Hippocrates, "has been long since established; and the method and way of discovering, as they have already done, several excellent things which assist to discover several others, if the inquirer be fitted for it; and being acquainted with the former discoveries, follows the old track: he that rejects all that has been done before and takes another road in his inquiries, boasts of finding out of new things, but deceives himself, and others with him."

Of these systems of physic I allude chiefly to that of the "mechanical," the "chemical," and the "humoural," and to the doctrines of Stahl.

The mechanical and chemical pathologists;

It was the discovery of the circulation of the blood which led to the *mechanical* doctrines, upon which the system of one school was founded: the disciples of the *humoural* and of the *chemical* pathologists adopted, in their turn, doctrines by which they attempted to explain all the phenomena of disease, and lay down principles for their cure, by producing changes in the qualities of the *fluids*.

and of Stahl

Observing the natural or instinctive processes of the economy to relieve the system in disease, Stahl founded his system, and taught the doctrine, that NATURE cured all diseases; and that the whole animal economy was governed by the "soul of man,"—a doctrine, however, which may be found in the works of the Father of Medicine, who considered NATURE as the "directress of the whole animal economy."

Doctrine of Hippocrates.

To this, which Hippocrates called "NATURE," he ascribed a mighty power: "Nature is of herself sufficient to every animal, and that in all respects she performs everything to them, without needing the lest instruction from any one how to do it." And again—"It is this faculty which gives nourishment, procreation, and growth to all things."

Of that doctrine which teaches us to take NATURE as our guide, or to trust solely to her efforts, enough has surely been said to prove how much the practice of the healing art is to be directed by a comprehensive knowledge of the various means which the animal economy possesses for the cure of disease.

"In how many instances," observes the learned Cullen, "the effects of the operations of Nature have been falsely imputed to the operations of medicines, need hardly be said. From the first beginning of physic to the present day, it has been generally supposed that many diseases are cured entirely or chiefly by the operations of Nature; and that many of the cures, supposed to be effected by medicine, are often effected by nature alone." "Trusting alone to Nature may induce too much caution, but it corrects rashness." And again he observes, "After so many evident instances of them (instinctive powers), we can hardly doubt but that the like powers take place also in obscure internal parts in many cases of disease, which are spontaneously cured by the operations of Nature, or, in other words, by the spontaneous powers of the animal economy."

Cullen's *Materia Medica*.

Cullen.

Errors of the disciples of Stahl.

But, in confiding alone to the powers of the animal economy for the cure of disease, the practice of the disciples of Stahl became inert; being led to neglect the use of some of the most powerful remedial means employed by the disciples of the other schools, the supposed effects of these remedies not according with the general principles which Stahl had adopted; neither could these effects be explained by the vague theories and hypotheses upon which the humoural and chemical pathologists had built on erroneous physiological doctrines.

Doctrines of the elder pathologists rational.

Thus it appears how well-founded have been some of the doctrines of the elder pathologists; and however much these doctrines may have been disregarded by the moderns, yet it seems to me impossible, either to give a satisfactory explanation, or to establish any sound principles for the treatment of diseases, without admitting the validity of, and adopting some portions of each of these systems, but, more especially, of that system which is built upon the powers which the animal economy possesses to cure disease; that doctrine for which, as I have said, we are indebted to the Father of Medicine.

How the processes of the economy are to be imitated.

Having premised these observations on the powers which are possessed by the animal economy for curing disease, we are next led to inquire into the means, by which these processes can be *imitated;* as according to the doctrine which I have endeavoured to establish, the whole art of the practice of physic is to administer these remedies at the proper stages of disease.

It has been pointed out that the mechanical and the chemical processes of the animal economy have but an imperfect analogy to these processes in dead matter; and as such differences are produced by the agency of the *vital* principle, we must not anticipate that, in the treatment of disease, much aid will be derived from the use of remedies which are either purely mechanical or chemical; or, at all events, that when such curative means are successfully employed, they can only act along with, or under the guidance and control of, those vital powers which regulate the healthy functions.

Indeed, when looking back to the period when any of these remedies were first employed, we almost invariably find, that a knowledge of their curative powers was quite accidental, and that it was not until long after their remedial effects had been well ascertained, that chemical and physiological science gave a rational explanation of their modes of action.

The mechanical processes.

The *mechanical* means, also, to which I have alluded, when explaining the phenomena connected with respiration and circulation, had been long known; and the various *instinctive acts*, by which they are modified, and by the imitation of which disturbances in the circulation are alleviated, were also in use long before the nature of the instinctive processes of the economy were explained.

and the chemical processes.

Such also is the case as regards the *chemical* remedies; for, in scarcely any instance does it appear that the chemical philosopher has been the first to point them out; he only explained their action after their utility in the treatment of disease had been long and incontrovertibly established.

All the processes of the economy cannot be imitated.

The chasm seems, indeed, to be so wide, and the differences in the processes which are performed in the vital and in the chemical laboratories so great, that it is not reasonable to expect that we shall be ever able to imitate the one by any knowledge which we may acquire of the operations of the other.

One essential difference, however, chemical science has revealed between those matters compounded in the vital laboratory which are absorbed into the body, and which are discharged from it; or between the *incrementitious* and the *excrementitious* compounds; the first cannot be imitated by any chemical process, whilst the latter resemble the compounds of inorganized matter.

Chemical remedies have been accidentally discovered.

There are, as has been said, few diseases the principles for the treatment of which have been, originally, the result of the application of chemical science. Certain states of the *urine* may be relieved by the exhibition of chemical remedies; but, generally speaking, almost all the morbid changes of that excretion are the effects of imperfect digestion, by curing which, the natural properties of the urine are restored.

In diseases of the blood, chemical agents have a decided effect, of which the preparations of *iron* are a remarkable instance; and as modern chemists have shown, that the healthy blood also contains minute portions of copper and of lead, it is very probable that the good effects of the *sulphate* of *copper* and the *acetate* of *lead*, so long employed in the treatment of the diseases of the circulation, may be satisfactorily explained.

Millon.

The powerful effects of *alkalis* in the treatment of rheumatism, gout, and scrofula, in changing the qualities of the blood, have been known from a very early period of medical history; we are indebted to chemistry merely for an explanation of the chemical changes which such substances produce on the blood. In the history of the medicinal effects of *iodine*, the use of burnt sponge was known for the dispersion of morbid growths, long before chemical science explained the nature of the remedial element which the sponge contains.

But the triumph of our art in assuaging human suffering has been the discovery of the extraordinary effects of the inhalation of *ether* and of *chloroform*—a discovery which has conferred the greatest blessing on mankind, and for which we are not indebted to the chemists, although chemical science has since extended and improved our knowledge of anæsthetic agents.

"The physician ought not to be ashamed to inform himself, though by the meanest people, of remedies confirmed by experience. By this means, in my opinion, the art of physic grew up by degrees, that is, by amassing and collecting observations of the several particular cases one by one, which, being all put together, make one entire body." Hippocrates.

CHAPTER XXIX.

GENERAL OBSERVATIONS ON THE MODE OF ADMINISTERING REMEDIES IN THE DISEASES OF THE HEART.

Difference in the effects of the same medicine in different persons and at different times; causes of these differences; errors in the mode of estimating the doses of medicine; remarkable effects of small doses; the order in which medicines should be administered; effect of combining different medicines; the accumulative effect of medicines; the effects of changing medicines; discordant opinions of the effects of medicines, and of their different doses; how such discrepant opinions are to be reconciled.

Previously to considering the particular remedies which are employed in the treatment of diseases of the heart, there are some general observations which it may be useful to make upon "the mode of administering medicines," as such observations will be found equally applicable to the treatment of all the diseases of this important organ.

Subjects here treated of.

I allude to the effects of medicines on different persons, to the different doses, to the order in which they should be administered, to the effects of their different combinations, to their repetition, to their cumulative effects, to the effects of changing one for another of the same class, to the discordant opinions of their effects, and of the proper doses;—all which are points well worthy of a separate consideration.

Here it may be mentioned, that the observations which I have to offer on the treatment of the diseases of the heart, must be considered as the result of long experience and careful observation on a multitude of cases of disease, amongst all classes of the community. By nothing is the young practitioner more apt to be misled, than by having general rules laid down for conducting the treatment of disease, when those rules have been derived from observations made only on a particular class of society. It has been justly remarked by Cabanis, that "the practice of medicine is reduced to a few simple rules in the country and in hospitals; but it is obliged to multiply, to vary, and to combine its different recourses, when applied to men of letters, to artists, and to all persons whose lives are not devoted to mere manual labour." This rule is, in a special manner, applicable to disorders of the heart, most of the diseases of the heart which affect the "working classes" of the community being of a perfectly different character from those whose avocations are chiefly intellectual, or who indulge in habits of idleness and dissipation.

Observation of Cabanis.

It is necessary to be aware, that very different effects are produced by the same medicine when given to different persons, even under apparently the same circumstances: this observation also applies to the same medicine when administered at different times to the same individual. "The medicines which agitate in health may soothe in disease."

Causes of differences in the effects of the same medicine.

Hippocrates.

It is also of consequence to mark the proper time to discontinue the use of a particular medicine. The medicine which will produce a most beneficial influence when disease is present, will be injurious to the same person when in health; and, therefore, when a medicine has been continued long enough to relieve the disease for which it was prescribed, its longer continuance may become injurious. Many persons with whom opium, calomel, and other medicines, disagree when in health, or when suffering only under slight ailments, derive great benefit from their use when they are afflicted with a severe indisposition.

A lady who never could take a dose of mercury without great derangement of the whole system, was attacked with *peritonitis*, and her pulse sank after losing a few ounces of blood. I gave her a dose of calomel and opium every few hours, by which the inflammatory symptoms were rapidly subdued; but after the inflammation had abated, the continuance of the mercury was followed by all its former pernicious effects.

Case.

It is the same with antimony: in administering this medicine in disorders of the heart, it will be found, that whilst essential benefit is derived from it, and that it has occasioned neither sickness nor nausea, until the condition of the circulation for which it was administered be relieved, then, and not till then, does its continuance occasion derangements in the digestive apparatus.

This subject might, indeed, lead to a lengthened discussion; but it is sufficient here to remark, that all the remedial means which are employed for the cure of disease, may perform that office effectually; but if continued after the symptoms have been subdued, or when the body is in health, they have effects upon the system equally injurious. This may be observed in the treatment of the heart's diseases, where mercury is beneficially employed in the first stages of some of its inflammatory affections; whereas the continuance of that medicine in the subsequent stages of the disease, often produces injurious effects.

How the effects of medicines are altered.

It is extraordinary how the effects of medicines are changed by apparently trifling differences in their quantity—in their combinations—in the condition of the stomach—and in the period of the day when they are administered. Hence the discrepancies in the opinions which have been promulgated of the effects of the same medicine, may often be satisfactorily accounted for; a knowledge of such differences is of essential utility in the practice of the healing art.

Erroneous mode of estimating the doses of medicine.

An erroneous, though a very common mode of reasoning in administering medicines is to suppose, that if a certain dose of a remedy produces certain effects, these effects will be *doubled* if the quantity of the medicine be doubled. It might, I think, be advanced as a general maxim, that quite the contrary usually takes place; that whether a dose be increased or diminished, not only are the effects different, but entirely new effects are produced.

What can better illustrate this observation than the differences in the effects of small or large doses of opium, or of alcohol; small doses invigorating the system, and large doses depressing the animal powers. It is the same with calomel, aloes, and with many other medicines. One grain of calomel will often purge the bowels violently, whereas five, or even ten grains of that medicine are often administered to relieve a diarrhœa; a large dose of aloes has commonly very little sensible effect on the digestive canal, whilst a single grain usually acts as a powerful evacuant.

The quantity.

There is much difficulty in establishing the proper doses of medicines; attention must be paid solely to their sensible operations, disregarding altogether any preconceived opinions of what may be the effects of any particular quantity.

Very unforeseen effects of medicines are sometimes discovered from very large or very small doses being accidentally administered, or from medicines being continued much longer than was intended.

Case.

A "house-painter," who had an ulcer on his leg, and whose general health was considerably deranged from habits of dissipation, was ordered a dozen of pills containing each two grains of calomel. I did not see him again until fifteen months after, when he informed me that his leg soon healed after commencing the pills, and that he had taken one every day since!

Case.

Mr. Paget had occasion to perform an operation on a gentleman, eighty years of age, and apparently in good health, who had taken one grain of calomel every night for the previous twenty-five years.

Case.

To show how little effect may be produced upon the system by large doses of some medicines, a young lady swallowed no less than *seven drachms of calomel*, six of which were afterwards separated from the alvine discharge, in so pure a state that her medical attendant administered it to other patients; on some of whom it produced salivation.

The small dose of a medicine is absorbed, and mixed with the blood, whilst a large dose passes through the alimentary canal unchanged. From taking too large a dose of poison, the life of the suicide is often saved; the economy resorting to the acts of vomiting and purging to remove the noxious matter from the body. It is the same with alimentary substances: if these are taken in too large a quantity, they pass, undigested, through the alimentary canal.

Efficacy of small doses.

This leads me to make an observation which will be found of very general application,—that for the cure of diseases *small* doses of drugs are generally more useful than *large* doses. I mean that small doses, whatever the medicine may be, are more effectual in the cure of many diseases, than the same medicine when used in large quantities.

Without going further into this question, I may remark, that wherever medical treatment has been found most beneficial, the relief has been usually obtained, not from large doses or large quantities of a medicine, but from small quantities and small doses; at least this is the result of my own experience. And what can illustrate this more strikingly than the cure of some long-standing syphilitic eruption, by giving one-tenth part of a grain of corrosive sublimate every second day for a couple of months, and in a case which had resisted both large doses and long-continued courses of mercury? How often do we find that small doses of purgatives act freely on persons on whom large doses of the same medicines have comparatively little effect? The successful practice of Haygarth, who gave five grains of *cinchona* for the cure of rheumatism, in place of the usual dose of half a drachm, or even a drachm of that medicine, is another illustration of the same principle. With regard to *iron*, small doses of its preparations appear often to have more effect than those which are much larger: in all probability this difference arises from the absorbents being able to take up only small portions, rejecting the larger dose.

Effects of the combination of medicines.

Besides differences in the effect of medicines from differences in the dose, essential differences are also caused by administering them *combined* with one another—effects which cannot be explained, and which nothing but practical observation can alone determine. This is remarkable in opium; in its combinations with a neutral salt, such as the citrate of potass, or the sulphate of magnesia, or with calomel, its effects are greatly modified.

Order in which medicines ought to be given.

There is no point deserving more attention in the administration of medicines than the *order* or succession in which they ought to be given; if this be disregarded, their effects are often completely changed. A blister has a very different effect after blood-letting, than before it; and opiates produce a very different influence on the system before, than after, the bowels have been evacuated. "There be many medicines which by themselves would be no cure, but perhaps hurt; but being applied in a certain *order*, one after another, do great cures."

Bacon.

Further, the *accumulated* effects of medicines ought also to be kept in mind in conducting the treatment of diseases of the heart; and although little has been said on this subject in works on therapeutics, the fact is well known to many men of experience. From not being acquainted with this circumstance, instances are not rare, where many doses of purgatives have been taken with but little sensible effect, until after a certain number of days have elapsed, and suddenly they have acted violently, and often to a hurtful extent: the same has been frequently observed as regards *digitalis*.

Medicines may be changed advantageously.

Here I may allude to the benefit which is sometimes to be derived from *changing* the medicine in the treatment of many diseases of the heart; by which is to be understood, that when the beneficial effects of one medicine appear to cease, another of the same *class* may be successfully resorted to; as, for instance, the preparations of iron may be replaced by those of copper or of zinc; the effects of all these medicines upon the circulation being very analogous. "It helpeth, both in medicine and in aliment, to change, and *not* to continue the same medicine or aliment still."

Bacon.

Discordant opinions of the effects of medicines, how caused.

Another observation may be opportunely made here, as it may be useful to the younger members of the profession, that when for the treatment of a disease there are several *different* modes recommended, which appear to be so opposite and so incompatible with each other, that they may be induced to suspect the accuracy, or even the veracity of the observers; whereas, if they had the opportunity of witnessing the treatment of any particular disease conducted by several physicians, a difference more or less remarkable would be observed in the practice of each, though the general principles they all adopted might be the same, and the result of each mode of treatment be equally satisfactory.

In the administration of medicines, experience and personal observation alone ought to be our guide; and we must be satisfied with knowing the particular effects that each medicine produces on the different organs, without attempting to explain these effects. What can be more inexplicable than the influence of ipecacuanha on the stomach, aloes on the rectum, mercury on the liver, belladonna on the iris, and digitalis on the heart?

How or in what manner these medicinal bodies act upon the different organs, and what changes they produce in the vital laboratory, has hitherto evaded research. It is true some have a direct influence upon the nerves of the stomach; some appear to exercise their influence upon the cerebro-spinal system; others must be first mixed with the blood; some affect only a particular organ; but of the laws by which all these varied changes are governed, we are totally ignorant.

The local and general treatment.

In the treatment of the diseases of the heart, as in that of all other organs, it is most essential to consider both the *general* and the *local* treatment, and likewise the order in which the remedies of both classes should be employed.

The greatest caution is always required in the use of local remedies, as in most instances they are far more frequently hurtful than beneficial. This seems to me usually to arise from the attention of the practitioner being chiefly arrested by the local symptoms, and from the sick being always inclined first to apply some local remedy to the diseased part. Whereas, it is of the greatest importance to endeavour, in the first place, to mitigate the *general* symptoms; and when these are subdued, local remedies may then be advantageously, and never dangerously employed: for when the local symptoms are subdued without such previous general treatment, it then often happens that some internal mischief remains.

Hence, in the treatment of the heart's diseases, it is not only essential to discriminate, and distinctly trace the primary affection to its origin in the heart; but it is equally essential that the condition of the other systems which are deranged should be accurately noted; for, in all cases, it becomes a nice question to determine the order in which the remedies for each should be employed. Before commencing the use of "cardiacs," it may therefore, be necessary to improve the condition of the digestive organs, by evacuating any morbid secretions collected in the alimentary canal.

Channels by which medicines are administered.

The mode in which medicines are exhibited is also an important consideration in the treatment of diseases. Some can only be given in a solid, and some only in a liquid form; some may be absorbed by the gastro-pulmonary mucous surface, by the skin; and these different channels have each their advantages.

The absorption of medicines, and their peculiar influence on different portions of the *gastro-pulmonary mucous surface*, are worthy of remark.

Nothing is more striking than the effects of some medicinal substances when put upon the *tongue*, especially in the form of powder. Repeated observation has satisfied me, and I am confirmed in this opinion by the experience of others, that calomel, tartarized antimony, and other medicines, when put upon the tongue, not only act much more speedily, but a less quantity is necessary to produce the same effect than when taken in any other manner.

The effects of "croton oil" when put on the tongue, a practice derived from the Chinese; and of medicines given in the form of "lozenges," show the effects which these substances produce on the economy without entering the stomach.

The rapidity in the effects of medicines, when put on the tongue, may be satisfactorily explained by the anatomical fact, that the "papillæ" are furnished with absorbents which terminate in veins in the neck, so that the medicine is at once conveyed to the blood; whereas, had it been taken into the stomach, it must not only have been mixed into the food, but its transit to the blood would have been far more circuitous.

"The spirituous parts," observes Haller, "more especially of vegetables, either penetrate into the 'papillæ' themselves, or else they are absorbed by the adjacent 'villi' of the tongue, as appears from the speedy restitution of the strength by vinous and aromatic liquors; for this restitution takes place even before they are received into the stomach." Haller.

For the treatment of diseases, it may be remarked, that the remedies are extremely few. Though the number of different medicines be considerable, yet many of them have effects nearly similar on the human body. It will, therefore, be generally observed, that those who have longest and most successfully practised the healing art, use a much less variety of drugs than the junior members of the profession; and also, that in proportion as a case is accurately or imperfectly understood, are the prescriptions simple or complicated. It is the same in all the other arts of life—the most skilful and the most dexterous mechanic always makes use of the fewest implements.

CHAPTER XXX.

GENERAL OBSERVATIONS ON THE REMEDIES EMPLOYED FOR THE TREATMENT OF DISEASES OF THE HEART.

THE MECHANICO-VITAL PROCESSES.

The remedial means are in strict imitation of the curative processes employed by the animal economy; they are either mechanical or chemical, under the control of the vital principle; the mechanico-vital processes; influence of modifications in respiration in disorders of the heart; these are produced by limiting the respirations; by quickening respiration; by artificial respiration; effects of swinging and rotatory motions, of exercise, and of rest; the curative effects of emetics and nauseants in disorders of the heart; curative effects of abstracting and of diminishing the quantity of blood.

We come now to consider the application of the different remedies for the treatment of the diseases of the heart, the effects of all which will be found to be in strict imitation of those processes which the economy itself employs for the cure of diseases; and there is no organ, or system of organs, where the application of these remedial means can be so amply illustrated, and their practical utility so satisfactorily shown, as in the treatment of the diseases of the sanguineous system.

The mechanico-vital processes imitated.

These processes of the animal economy, I have endeavoured to show, are either mechanical or chemical, under the influence and control of the nervous system, or of a vital principle. In discussing the various means by which such processes can be imitated, let us first consider those which are mechanical, and which may with propriety be designated *mechanico-vital* processes.

Modified Respiration.

The heart being a mechanical apparatus, especially intended to propel the vital fluid throughout the system, we can readily comprehend how some of its functions may either be disturbed or restored by *mechanical* processes; hence we find, that the respiratory organs perform an important office, not only in remedying temporary disturbances of the circulation, but also, when these are diseased, in relieving disorders of the heart.

Changes in the circulation caused by them.

I have explained how the circulation is altered by those various changes in respiration which are resorted to *instinctively* by the economy, not only to relieve the temporary disturbances to which the circulation is subject, but also by the *vis medicatrix*, to restore the balance of the circulation in some of those derangements which are caused by diseases in the heart. Now, these acts which Nature employs, point out the principles on which most rational artificial means of treatment ought to be conducted; and assuredly, the great influence which modifications in respiration have on the action of the heart opens an interesting field of inquiry, pointing out a channel for relieving disturbances in the circulation, which has not met with that consideration which it so well merits.

The means of imitating some of the instinctive processes of the economy, by which disturbances of the circulation are restored, consist in shortening or prolonging either the inspirations or the expirations.

The *inspirations* may be shortened by keeping the mouth shut, inspiring only through the nostrils; or by placing a belt round the chest, so as to prevent the expansion of its parietes; and respiration may be variously modified by swinging and by rotatory motions; by sea-sickness, emetics, and sternutatories.

Some of the natural processes cannot be imitated.

But whilst some of the mechanical processes employed by the animal economy can be imitated, there are others which are beyond the reach of art. We have no means by which we can imitate sobbing, sighing, laughing, crying, or coughing; though all these acts are employed by the economy instinctively, and have a decided effect in relieving temporary disturbances in the circulation.

Curative effects of limiting inspiration.

There are some disorders of the heart which can be relieved by *limiting* the inspirations, or by changing their frequency.

I have formerly shown that it is necessary in the healthy condition of the thoracic viscera to inflate the bronchi only to a certain extent, in order to preserve the free circulation in the pulmonary capillaries; and that if the air-cells be distended beyond such limits, the circulation in the capillaries will then be obstructed, and pulmonary congestion will necessarily follow. In order, therefore, to prevent the air-cells from being too much distended, if the mouth be kept shut during inspiration, there is considerably less expansion of the chest than what takes place when a full inspiration is made with the mouth open.

Modes of limiting the inspiration:

This interesting anatomical fact described by Sir Everard Home, but which has hitherto been disregarded by pathologists, affords not only a satisfactory explanation of certain contrivances, which have been resorted to for enabling persons to perform bodily exertions, but it also explains the operation of those means which, experience has taught, afford relief in some ailments of the chest.

shutting the mouth,

In running a race, it is the usual practice to put a pebble or some such substance in the mouth, which has the effect of keeping it constantly shut. The case of a person has been mentioned, who had a great reputation for teaching elocution, and who taught the student to acquire the habit of reading aloud for a lengthened time by keeping the mouth shut, and only breathe through the nostrils, during each inspiration, so that in both cases the inspirations were limited, and the bronchi prevented from being so much distended, as to cause any obstruction to the circulation in the pulmonary capillaries.

To effect a similar purpose, those suffering from a disordered circulation, and more especially those who have coughs, resort to various contrivances, the *modus operandi* of which can thus be satisfactorily explained.

The influence of limiting the inspirations on the action of the heart may be also illustrated by the good effects of *lozenges*, so commonly made use of to relieve coughs; the necessary consequence of the mouth being kept shut by a lozenge is, that breathing is carried on through the nostrils only, and thus the air-cells of the lungs are not sufficiently distended to impede respiration, which would happen, if the inspirations were more full, by air being also admitted through the mouth.

(Case)

A gentleman who had an embarrassment in breathing, kept a pebble in his mouth for fifteen months, from which he experienced great relief.

Applying a bandage round the chest.

Inspirations can also be limited by applying a belt or *bandage* round the waist, sufficiently tight to limit the expansion of the chest during inspiration,—a practice not unfrequently adopted by persons who are about to make great muscular efforts, and one which may be employed to relieve disturbances in the heart.

Case recorded by Dr. Gibbs, of Clifton.

"A bandage was applied pretty tightly round the chest and part of the abdomen, in a patient whose respiration was very laborious, and who had been bled and had tried other remedies for three days previously. The breathing became gradually more easy; and in the course of twenty-four hours it became so easy, that the patient could walk gently about the house. The young woman, who was about twenty years of age, had enjoyed good health until a week before the dyspnœa commenced."

Influence of full inspirations.

The relief in breathing which is obtained by limiting the inspirations is directly opposed to that relief which is obtained in certain affections of the head; the most remarkable features of which are very full inspirations accompanied with deep sighs.

It has been already shown, that, by the act of *inspiration*, the return of the venous blood to the lungs is accelerated, the expansion of the chest causing it to be pressed forward by the agency of the atmospheric pressure into the veins of the right heart, and thus assisting the circulation in both *cavæ* veins. But when, from any cause, a preternatural quantity of blood stagnates within the head, the inspirations then become lengthened, which, by still further increasing the velocity in the current of the venous blood to the heart, causes any superabundant quantity to be abstracted from the brain.

On this principle can be explained the temporary relief obtained in some headaches by protracted and very full inspirations, and the involuntary long inspirations and deep sighs which are frequently observed in those suffering from disease and injuries of the brain, and which full inspirations will, undoubtedly, facilitate the return of the venous blood from the head.

Curative effects of modifications in respiration.

Cases of diseased heart have already been alluded to, where, by *modifying* the breathing, temporary disturbances in the circulation might be restored; so that it is easy to comprehend, how irregularities in the heart's action may often cause changes in respiration, and how, by these changes, the hurtful effects of the irregular action of the heart in altering the supply of blood to particular organs are warded off.

Effects of sternutatories.

The effects of *sneezing* upon the action of the heart, and of the remarkable consent between the organ of smell and the central organ of the circulation, has been already pointed out; and it has also been mentioned, that the act of sneezing is sometimes a symptom of a disturbed circulation. On the other hand, particular smells cause a disturbance of the heart; so that the reciprocal influence of these two organs explains the remedial effects of *sternutatories* on disturbances of the circulation.

Effects of singing; and speaking.

The case of a lady has been mentioned with a disordered heart, who had frequently been attacked with *syncope*, and who accidentally discovered that she could ward off a paroxysm by an alteration in breathing, which she made by the effort of *singing;* and also the case of a youth with an irritable heart, who was often attacked with *fits*, and when warned of their approach, he used to be able to mitigate greatly the paroxysm by repeating a few sentences in a subdued tone of voice.

Curative effects of swinging.

The deranged state of the heart which is present during a hysteric paroxysm has been relieved by modifying respiration by *swinging.*

Cases recorded by Mr. Crocker.

"A young lady affected with hysteria thought of a remedy for herself to check the *convulsive* fits. Whenever she felt intimation of an approaching attack, she instantly repaired to the garden, where there was a swing; and swinging invariably relieved her. She was carried to it, even in the midst of a paroxysm, when it might have been thought impracticable, from her violent agitations; yet the moment the swing was put in action the paroxysm ceased."

Gazette of Health. 1826.

This remedy was adopted by Mr. Crocker in a case of a girl nineteen years of age, attacked by *hysteria.* "She was taken out of doors to the swing in a child's chair, on account of her being partly deprived of the use of her lower extremities; and it was found that the action of the chair had an effect almost similar to that which the swing had in the other patient."

Curative effects of artificial respiration.

When the action of the heart has become extremely languid, or when it has even ceased to beat, as in some cases of syncope and asphyxia, its action may be restored by *artificial respiration*, employing, at the same time, those means which invigorate the heart—such as the administration of alcohol and ammonia, and the compression of the humeral arteries.

Such, indeed, is the influence of respiration on the circulation, that we have it in our power to produce very considerable changes in the action of the heart, either by quickening or by retarding respiration.

Case.

John Hunter, we are told by his biographer, on one occasion, when both respiration and circulation had for some time ceased, saved his life by making a powerful effort to respire. "After having taken a dose of laudanum, whilst he was walking about the room, he cast his eyes upon the looking-glass, and observed his countenance pale, his lips white, giving him the appearance of a dead man. This led him to feel for his pulse, but finding none in either wrist, he now thought his complaint serious; several physicians of his acquaintance were sent for, but none of them could find a pulse; the pain still continued, and he found himself at times not breathing. Being afraid of death soon taking place if he did not breathe, he produced the voluntary act of breathing by working his lungs by the power of the will; the sensitive principle, with all its effects on the machine, not being in the least affected by the complaint. In this state he continued for three quarters of an hour, during which time frequent attempts were made to feel the pulse, but in vain; however, at last the pain lessened, and the pulse returned, although at first but faintly, and the involuntary breathing began to take place."

Artificial breathing has been employed to restore life when apparently extinguished from a want of power in the heart to circulate the blood.

In *asphyxia* from drowning, hanging, or breathing noxious gases, artificial respiration is a most powerful restorative process; and when the heart's action is destroyed by poisons, artificial respiration is no less useful in restoring animation.

A remarkable example of a man, "dead in appearance," and in whom no pulse in the heart nor in the arteries could be distinguished, from having breathed a noxious gas in a coal-pit, was completely resuscitated by artificial respiration.

Case recorded by Mr. Tossach.

"The colour of the skin of his body was natural, except where it was covered with coal-dust; his eyes were staring open, and his mouth was gaping wide; his skin was cold; there was not the least pulse in either heart or arteries, and not the least breathing could be observed; so that he was to all appearance dead. I applied my mouth close to his, taking hold of his nostrils with one hand, and holding my other on his breast at the left nipple; I blew my breath as strong as I could, raising his chest fully with it, and immediately I felt six or seven very quick beats of the heart; his thorax continued to play, and the pulse was felt soon after in the arteries. I then opened a vein in his arm, which, after giving a small jet, sent out the blood in drops only, for a quarter of an hour, and then he bled freely; in the meantime, I caused him to be pulled, pushed, and rubbed, to assist the motion of the blood as much as I could; washed his face and temples with water, and rubbed *sal volatile* on his nose and lips. Though the lungs continued to play, after I had first set them in motion, yet for more than half an hour it was only as a pair of bellows would have done, that is, he did not so much as groan, and his eyes and mouth remained both open.

"About an hour after he began to yawn, and to move his eyelids, hands, and feet; I then put water, into which I had dropped some *sal volatile*, into his mouth, which he swallowed, and caused him to be carried into a house hard by, where I set him in a chair reclining backwards. In an hour more he came pretty well to his senses, and could take drink, but knew nothing of all that had happened after his lying down at the foot of the ladders, till his waking as it were in his house.

Edinburgh Medical Essays.

"Within four hours he walked home, and in as many days returned to his work."

Here it may be noticed, that besides the mode of restoring respiration by inspiring into the mouth, or by inflating the lungs through the nostrils with a pair of bellows, the thorax may be alternately compressed and expanded by pressing it with the hands, the elastic cartilage which enters into its composition being sufficient to cause its subsequent expansion.

The movements of the chest during the act of vomiting have also been had recourse to, as a means of restoring respiration;

an emetic is used by coal-miners, to relieve the *asphyxia* which is caused by breathing impure air.

Holland's *Notes and Reflections.*

So powerful is the effect of respiration on the action of the heart, that artificial breathing has been successfully employed for restoring animals, when life had been apparently destroyed by poison taken as a remedy; the poison having been administered to destroy animation during a sufficient length of time to arrest the progress of the disease.

"The experiment of resuscitation having succeeded, it was very natural to suppose that efforts would be made to turn it to advantage; for it was conjectured that, if existence could be destroyed and restored again, the destruction of existence might also remove local or organic disease, and the artificial respiration produce a new life in every sense of the term. The first trial of this was made by Mr. Sewell, an eminent veterinary surgeon of London, on a horse labouring under *tetanus* and locked jaw. The poison was inserted in the fleshy part of the shoulder, and in ten minutes apparent death was produced. Artificial respiration was commenced, and persevered in for four hours, when reanimation took place, and all the symptoms of *tetanus* were cured."

United Service Journal, 1839.

How far it may ever be expedient to imitate such experiments, and extinguish human life for a while, and restore it again after disease is subdued, is a matter of grave consideration. At the same time, we cannot help being struck with the use that has been made of *chloroform*, the effects of which closely approximate to the experiments made with the *wourali* poison on animals. The approximation is the more remarkable when we consider that this poison is a compound, of which one of the essential elements is the *red ant.*[1]

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[1] "A day or two before the Mascoushi Indian prepares his poison, he goes into the forest in quest of his ingredients. A vine grows in these wilds which is called wourali. It is from this that the poison takes its name, and it is the principal ingredient. When he has procured enough of this, he digs up a root of a very bitter taste, ties them together, and then looks about for two kinds of bulbous plants, which contain a green and glutinous juice. He fills a little quake which he carries on his back, with the stalks of these; and, lastly, ranges up and down till he finds two species of *ants*. One of them is very large and black, and so venomous that its sting produces a fever; it is most commonly to be met with on the ground. The other is a little *red ant*, which stings like nettle, and generally has its nest under the leaf of a shrub."—Waterton's *Wanderings in Guiana.*

Exercise and Rest.

As involuntary muscular movements are one of those means employed by the *vis medicatrix naturæ* to invigorate the heart, the beneficial, as well as the hurtful effects of the different kinds of exercise to those who are afflicted with maladies of the heart, may be satisfactorily explained.

In a fit of *syncope*, and also in other fits, convulsive movements take place towards their termination, the musculo-cardiac function increasing the quantity of blood within the heart, and thus restoring the vigour of the circulation. For the same reason the muscular movements which are made in the various kinds of exercises produce their good effects by increasing the blood in the heart, and consequently its vigour.

"Gymnastic Physic" was inculcated as a useful branch of the healing art by the earliest physicians. Esculapius ordered "some to ride on horseback, and to exercise themselves in their arms; and he showed them the several sorts of motions they were to express, and after what manner they were to be armed." Le Clerc.

Persons in health are capable of taking very different kinds of exercise without fatigue. Some are able to ride on horseback; some to walk; some to run; and some to row a boat; but those who can perform one of these, cannot perform any of the others to a like extent with corresponding ease. Thus a trained dancer cannot walk even a short distance; the post-boy, who is accustomed to ride many miles every day, is easily fatigued by walking; and there are many persons who can walk great distances without fatigue, but who are unable to ride but a few miles. The extraordinary power which the muscles of the hand acquire in musicians, shows what a great rapidity of action some muscles may acquire, and not be fatigued; and this in persons who appear to have little vigour in other muscles. A man, therefore, must be "trained" to the particular kind of exercise which he is required to take: in recommending exercise for the purpose of promoting health, it ought to be commenced gradually, and very gradually increased.

But when the heart is disturbed, all those exercises, so useful in preserving health, now become more or less injurious. Every movement which tends to increase the quantity of the heart's blood, ought therefore to be guarded against by those who suffer from a disease of the heart. Medical records abound with cases of persons dying suddenly from some inordinate muscular exertion, causing such a congestion of blood which the heart could not evacuate, and in many instances even rupturing the heart's parietes. John Hunter, who had a diseased heart, dropped down lifeless when in a violent passion; Abercrombie expired from a rupture of the right auricle, whilst making an effort to evacuate the bowels.

Rest.—Bodily tranquillity is of essential utility in the treatment of diseases of the heart. The action of the heart being increased by the slightest muscular movement, the influence of a perfect repose of the muscular system must be a useful curative means in many diseases of the circulation.

The frequency, both in the action of the heart and in respiration, is diminished when a person is in the horizontal posture; and if in bed, the warmth and equal temperature contribute greatly, by sustaining the action of the skin, to alleviate disease.

The system of treating *aneurism*, recommended by Valsalva, derives much of its benefit from the perfect rest, so strictly enjoined, along with the depletive system; and I am convinced that in many diseases of the heart much benefit may be derived from bodily repose, nothing being more remarkable, in almost every disorder of the heart, than the pernicious effects of muscular exertions.

Hurtful as all bodily exertions must be, of still more importance is it to avoid any mental excitement in the treatment of diseases of the heart.

Blood-letting.

Of the remedies employed for the treatment of diseases of the heart, there are none more important than those means by which we can either increase or diminish the quantity of the blood within the heart.

The *modus operandi* on the heart.

The curative effects of abstracting blood in diseases of the heart are twofold; one is produced by changes in the circulating apparatus, from a diminution in the quantity of the fluid contents of the heart's cavities: this effect of abstracting blood when the cavities of the heart have become congested, has no analogy to its effects in any disease of other organs; for there is no organ in which the blood is contained elsewhere than in the blood-vessels. The other is produced by abstracting from the system a portion of the vital element in the inflammatory diseases of the heart. The effects of blood-letting are the same, as when employed in the treatment of inflammatory diseases of other organs.

The blood in the cavities of the heart may be diminished, either by abstracting it from the system, or it may be removed from the heart to some distant part of the body by "derivatives;" both which processes are resorted to by the animal economy for the cure of disease.

Blood-letting, an imitation of nature.

Of the curative processes employed by the economy, there is certainly no one more remarkable, or more worthy of imitation in the treatment of the disorders of the heart, than *spontaneous hæmorrhages:* such bleedings taking place either from the nasal, the bronchial, the cerebral, or the hæmorrhoidal vessels; and so beneficial are such bleedings, that there are many persons who, at some remote period of life, having lost repeated and even large quantities of blood, could narrate the history of an affection of the chest, which had entirely vanished from the period of the hæmorrhage.

Its great utility.

Blood-letting may be considered one of the most valuable curative means employed in the treatment of the diseases of the heart. The abstraction of blood is no less useful in mitigating the inflammatory affections of the heart's structure, than in subduing those diseases in other organs: it is the only means which we possess of removing blood when a superabundant quantity is collected in the cavities of the heart, or when it is in a state of *congestion.* It may, therefore, be said, that there is almost no malady, to which the heart is liable, wherein blood-letting is not useful during at least some period of its progress.

Two different purposes effected by it.

In the treatment of disorders of the heart, I have said that blood may be abstracted for either of two very different purposes; it may be employed to relieve a congestion of the cavities of the heart, or to subdue an inflammatory state of any of the heart's tissues; and the difference of the *modus operandi* of blood-letting in these two cases, will point out the rules by which we ought to be guided in adopting it in each.

In the inflammatory affections of the heart, blood-letting is a remedy as powerful as it is in the treatment of inflammatory affections of other organs; and the general rules usually followed for adopting it are the same in both inflammatory affections.

Wilson's *Lectures on the Vascular System.*

"In all the *phlegmasiæ*, where the pulse is the chief indication for the treatment, we in fact do nothing but mitigate the state of the heart."

The quantity of blood to be removed.

The *quantity* of blood, which ought to be removed in disorders of the heart, is an essential point to determine in all cases where blood-letting is resorted to. As a general rule, I may remark, that in inflammatory affections of the heart, blood-letting should be employed to the same extent as in inflammatory affections of equal severity, and accompanied by febrile symptoms of equal violence in other vital organs. But in all cases of *congestion*, blood-letting must be resorted to with great caution; for although in inflammatory affections nothing subdues the symptoms so effectually as even a protracted state of syncope caused by the loss of blood, yet a fainting state is to be particularly guarded against where there is a sanguineous congestion; for should syncope be produced under such circumstances, there is danger of the patient not recovering from it.

"Whenever the congestion of the ventricles is vigorous, we may bleed without fear—the pulse will rise. But when the contractions are feeble, though the pulse may have a certain force, blood-letting should not be employed."

Laennec.

The quantity of blood to be abstracted, must vary in every case, and be entirely regulated by its influence on both the cardiac and the arterial pulse; for, when the force of the beatings of the heart is diminished, whilst the blood is flowing from the vein, the arterial pulse acquires volume, and becomes compressible; in no disease is this observation more correct than in congestion of the heart.

"When," observes Laennec, "the pulse and the heart are equally feeble, we must be cautious in opening a vein, whatever may be the nature of the disease, otherwise we should inevitably destroy the small resources left to nature."

Laennec.

The impropriety of employing blood-letting, in some injuries of the brain, arises from the danger of the depletion still further lessening the vigour of the heart; the powers of life being already much diminished from the "shock" caused by the injury to the brain. It is the same with regard to the heart.

The Comparative Effects of General and Local Blood-letting.

I have explained at considerable length in another work[1] the indications by which we should be guided in adopting one or other of these modes of blood-letting; laying it down as a general rule, that *general* is preferable to local bleeding in those diseases accompanied with fever; whereas, in disorders which are not accompanied by any febrile excitement, *local* blood-letting is preferable to general blood-letting.

This rule is not, however, so invariably applicable to the treatment of the affections of the heart, as to those of some other organs, from the circumstance, that the relations of the heart to the blood are very different from the relations of the vital fluid to the other organs of the body.

In all cases of inflammatory diseases of the heart accompanied by a febrile state of the system, general bleeding will be found preferable to local bleeding; but on the other hand, in all cases of sanguineous congestion, whether in the cavities of the heart or coronary vessels, leeches ought to be, in most instances, preferred to phlebotomy: by adopting this mode of abstracting blood, we completely avoid all those dangers which may arise from general blood-letting being carried too far.

Advantages of leeches.

One great advantage of bleeding by *leeches* is derived from the circumstance, that the quantity of blood which they withdraw seems to depend, at least in a great degree, on the fulness or particular condition of the vessels of the part where they are applied; so that the same number of leeches will withdraw much more blood applied on an inflamed hand, than applied on the sound hand of the same person. Hence the propriety and safety of this mode of abstracting blood in disorders of the heart; the quantity evacuated by a given number of leeches not depending on any preconceived notion of what quantity might be required for the relief of the disease.

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[1] *On Blood-letting*: giving an account of its curative effects, with rules for employing both Local and General Blood-letting in the treatment of Diseases. By James Wardrop, M.D., 1835.

Indeed, nothing shows more the preference which ought to be given to the use of leeches to the other modes of blood-letting, than the difference in the quantity of blood which is abstracted by them in a succession of bleedings on the same patient; each application yielding less and less blood, in proportion to the abatement of the symptoms, and to the diminution in the fulness of the vessels, thus pointing out in almost every case the propriety of pursuing or of discontinuing the depletive system.

In employing leeches, the slow manner in which the blood is abstracted, must have a very different effect on the system, from that when a quantity of the vital element has been suddenly removed by venesection.

That leeches abstract blood from the capillary system, is another peculiarity to be considered; so that the blood withdrawn by them is both arterial and venous; and it may be observed, that every leech usually vomits some red, and also some black blood.

A profuse spontaneous hæmorrhage from the capillaries usually causes little general debility, when compared to blood-letting, or to the bleeding from leeches. Very large quantities of blood may be lost from the uterus; from the lungs; from the nose; or from the alimentary canal, in persons who would be much weakened by even a moderate blood-letting.

Their application to the chest.

In disorders of the heart, leeches may be applied to any part of the parietes of the chest; but the *cardiac* region is generally to be preferred. The free inosculation of the external and internal mammary arteries,—the vascular communication between the internal mammary, and the arteries of the pericardium,—and the inosculations between these arteries and the coronary, or nutrient arteries of the heart itself, sufficiently explain the decided benefit which is derived from this mode of abstracting blood in disorders of the heart.

Applied to the feet.

Leeches may also be applied to the *feet*, as well as to the chest in disorders of the heart. However inexplicable this may be, I have had ample opportunities of testing the comparative utility of this mode of blood-letting in affections of the heart, being in

Comparative effects.

the habit of recommending the leeches to be alternately applied to the chest and to the feet; leaving the patient to repeat, when necessary, whichever mode afforded the greatest relief: in many cases a decided preference has been given to their application to the feet.

The number to be employed.

The *number* of leeches, which ought to be applied to the parietes of the chest, also deserves consideration. It is important to be aware, that the bleeding from their wounds is not in the ratio of the number which is applied, as is usually supposed; so much is the contrary the case, that I have often been surprised to find three or four leech-bites bleed much more in proportion, to what double or treble their number would have done. From this circumstance, whatever explanation of it may be offered, I have long been in the practice of using only three or four leeches; whereas formerly, in similar cases, never less than two or three times that number would have been applied.

Cupping is a mode of abstracting both arterial and venous blood, the effects of which are, in some respects, similar to the application of leeches. When the cupping is employed upon the back of the neck or between the shoulders, it appears to me to be an eligible mode of abstracting blood in diseases of the heart; because the arteries, from which the blood is abstracted inosculate with the intercostal and mammary arteries. Cupping does not, however, possess the advantage of leeches, which, as I have said, cause a flow of blood in proportion to the congestion of the vessels which they bite; whereas, the quantity of blood to be extracted by cupping can only be regulated by watching the changes produced on the radial and cardiac pulses.

There is also an effect of cupping materially different from that produced by the application of leeches. The action of the cupping-glasses, as well as the pain they create, cause a large flow of blood to the parts upon which they are applied; and, in employing cupping on other parts of the body, we often find that the flow of blood to the diseased part, caused by the glasses, does more harm than is the relief from the abstraction of the blood.

Difference in the effects of abstracting venous and arterial blood.

In another work[1] I have endeavoured to explain, at some length, the differences in the curative effects of abstracting *arterial* and *venous* blood,—a subject which had never claimed the notice of physiologists; arteriotomy being recommended in preference to venesection, merely for the purpose of getting a larger quantity of blood withdrawn in a shorter time, especially in affections of the head. It is, however, quite evident that the influence of abstracting venous or arterial blood must be very different, whatever be the claim that each of them may have, as the preferable curative measure.

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[1] *On Blood-letting*, &c. &c. By James Wardrop, M.D., 1835.

The removal of arterial blood—of the blood before the secretions have been separated from it, cannot have the same effect upon the system, as the abstraction of a like quantity of venous blood, after having parted with the essential elements of life.

The difference in the physiological phenomena resulting from *arteriotomy* and *venesection* is no less remarkable. The abstraction of *venous* blood causes little change in the condition of the adjacent venous system; the powers of dilatation which the veins possess, at once enable them to receive all the blood which would have passed along the wounded vessel. But when an artery has been wounded, to stop the bleeding it is necessary to divide it, and to place a ligature upon the bleeding orifice; a restorative process takes place almost instantly—a process to provide the parts which have been deprived of their arterial blood with a due supply from anastomosing branches; so that those structures which had become pale and bloodless, whilst the arterial blood was making its escape, may, immediately after the operation, be observed to be as much distended and reddened as before it was performed.

The morbid changes in the blood imperfectly investigated.

When investigating the changes in the *qualities* of the blood from disease, the chemical philosopher has surely erred in not analyzing the *arterial*, as well as the *venous* blood, and comparing the difference in the two bloods.

Arterial blood in diseases not yet analyzed.

Those changes which take place in the arterial blood, after it has passed through the various organs, and after the different secretions and excretions have been abstracted from it, must render any knowledge we possess of the diseased changes in the venous blood totally inapplicable to the changes of the arterial blood. An analysis of both bloods would doubtless be of great importance; and until chemical science reveals the changes which disease produces in the arterial blood, our knowledge of the morbid characters of that vital fluid must remain extremely limited and imperfect.

As a therapeutic agent, we know the curative effects of blood-letting, only by abstracting a *quantity* of it from the system, or from a particular organ ; but blood-letting is not resorted to as a remedial measure from any supposed changes that are produced by it in the *qualities* of the blood.

Blood, how to be diminished in the heart.

The blood in the heart may be *diminished* without removing any portion of it from the system ; and this can be accomplished by the common operation of *dry-cupping*, or by Junod's pneumatic apparatus applied to the extremities.

At the same time, *friction*, *rubefacients*, the *pediluvium* and the *maniluvium*, all produce their curative effects by diminishing the quantity of blood within the heart, and by assisting in restoring the due balance of the circulation.

Dry-cupping.

Dry-cupping has indeed been employed since the days of Hippocrates "to recall the course of the blood which was going where it ought not to be;" and I have repeatedly seen the same beneficial effects result from the dry-cupping as from local bleeding.

Case.

A young lady who had often successfully applied leeches to the cardiac region to relieve congestion, was led to try the effect of dry-cupping; and, in subsequent attacks, she experienced, on many occasions, as much benefit from the dry-cupping as from the bleeding.

Junod's Cupping-boots.

To diminish the quantity of blood in the heart by increasing it in the extremities, an ingenious instrument was invented and satisfactorily applied by Junod; and although the principle of abstracting blood from one part to another, by the removal of the atmospheric pressure, had been employed as a remedial means, yet originality is justly due to Junod's instrument, and its application to the treatment of disease.[1]

His method consists in employing a pneumatic apparatus, in which an arm or a leg is so placed that the quantity of blood in the extremity can be increased to any degree, and, consequently, a corresponding diminution in its quantity will take place in the trunk of the body.

Gazette Médicale, No. 25.

Blood, how to be increased in the heart.

The quantity of the heart's blood may be *increased* when it is required to increase the vigour of the circulation: this may be accomplished not only by the administration of internal remedies, but also by mechanical means,—such as by the compression of the arteries of the limbs, by the horizontal posture, by artificial respiration, and by muscular movements.

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[1] The priority of invention has been fully discussed in the *Lancet*, Vol. II., 1837-38.

By ligatures on the extremities.

Ligatures, placed upon one or more of the extremities, have the effect of increasing the blood in the heart, by impeding its flow in the arteries: I have formerly explained how the vigour of the heart is restored, either by placing a tight ligature upon a limb, or by the pressure of muscles during their contractions.

Utility of, in cholera morbus;

This method of restoring the vigour of the heart is particularly adapted to relieve *syncope;* it has been successfully adopted by Dr. Wise, in the treatment of *cholera morbus.* "When the patients are brought to the hospital, or when I see them first in a collapsed state of cholera, I give a pill, composed of assafœtida, opium, and capsicum; and I apply the tourniquet to the four extremities. This throws several pounds of blood into the trunk, and disturbs and removes the morbid action; and thus patients are cured when there is no chance with any other remedies."

(*Lancet*, Vol. II., 1848)

its utility and danger in syncope.

The compression of arteries must, however, be used in diseases of the heart with extreme caution. If *fainting* arises from a languor of the circulation, such as that which is occasioned by the loss of blood, the fainting state may be relieved by arterial compression; but if syncope be caused by congestion from changes in the heart's structure, thus diminishing its expulsive powers, then the evil will, in all probability, be increased by increasing the quantity of blood in the heart.

This leads me to repeat what has been said of the difference in the condition of the general system of a person in a state of *syncope*, and in a state of *apoplexy.* In syncope the whole of the powers of organic, as well as those of animal life, are diminished according to the degree of the diminution in the vigour of the circulation; whereas, in apoplexy, it is the powers of animal life only which are more or less destroyed, those of organic life remaining unimpaired.

For the relief of syncope, we must therefore have recourse to those means which will invigorate the circulation, and hence the danger of *blood-letting* in those who are in a state of syncope; whereas in apoplexy, the congested condition of the cerebro-spinal system points out the propriety of abstracting more or less of the vital fluid.

Nausea and Vomiting.

Nausea and vomiting are two other processes resorted to by the economy to restore disturbances in the circulation, which can be artificially imitated, and which are employed as remedial measures in the treatment of the disorders of the heart.

Magendie.

Considered separately, the phenomena of nausea and vomiting, and the influence of each of these acts upon the system, are so perfectly different, that conflicting theories and various conjectures have been made in order to explain their nature, and for what purposes they should be associated together in order to perform one act in the economy.

The observations which have been already made, and the explanations that I have offered, point out the influence of these processes, when artificially employed for the treatment of diseases of the heart.

When we consider their curative effects, we find that these effects differ in each act, and that they may either be separately produced, or that beneficial effects may be derived from both acts combined. The influence of vomiting, with nausea, upon the circulation, is an important consideration in the treatment of disease; as I have endeavoured to show that the vigour of the heart, and consequently the momentum of the blood's currents, are diminished by nausea, and that vomiting, by its mechanical action upon the heart, co-operates in restoring the disordered circulation.

Curative effects of nausea;

That there is a great change in the action of the heart during a state of nausea, and an influence of a very opposite character during a fit of vomiting, is quite evident: in proof of which we have only to observe the changes in the system during each of these conditions.

In *nausea*, the countenance becomes pale, and there is a general sensation of cold, a feeble pulse, great prostration of strength, along with moral depression.

But when *vomiting* commences, the face becomes flushed, there is a general sensation of warmth, the pulse acquires additional vigour, and, after the fit of vomiting, universal perspiration follows.

Though some degree of nausea precedes, and usually accompanies vomiting, I have said that nausea also takes place without vomiting, and is resorted to by the economy to relieve disturbances in the circulation ; at the same time, it is one of those remedial means which we can imitate by medicinal substances.

In the treatment of disorders of the heart, it is generally expedient to employ vomiting with nausea ; for, in those cases where the affection of the heart is sympathetic of a disordered stomach, it is not only requisite to evacuate the contents of the stomach, but also to restore the balance of the circulation : where the affection of the heart is primary, not only do we find relief from nausea, but the mechanical effects of vomiting contribute to restore the disturbed circulation.

Vomiting is employed by the economy for the purpose of evacuating noxious ingesta ; in making that evacuation, there is no effort made by the abdominal muscles, the contents of the stomach being removed by its own contractile powers.[1] So far, vomiting may be considered a mechanical act ; but when it is accompanied by more or less nausea, then, besides evacuating the stomach, the powerful action of the abdominal and thoracic muscles produce changes in the action of the heart and capillary system.

There are many disturbances in the action of the heart, arising from the presence of noxious and morbid secretions in the stomach, where immediate relief is obtained by their evacuation.

Sometimes the effects of noxious food, in disturbing the circulation, are apparent soon after it has been received into the stomach ; these disturbances are immediately relieved by an emetic. How frequently does it happen that the life of the suicide is spared by the dose of poison being so large, as to cause instant vomiting !

But food of an improper quality sometimes remains in the stomach for a much longer period, I suspect, than is usually supposed, and often causes a disturbance of the heart.

A young man ate some *onion*, and after six weeks of great Case.

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[1] Hale estimated the strength of the stomach on the aliment to be about 20 lbs.

suffering and derangement of the circulation, he vomited several portions of it; immediately after which he recovered.

Some emetic substances seem to act directly upon the stomach, and others are first absorbed into the blood, and thus influence the nervous system, or the portions of it from which those nerves emanate, which nerves supply the organs that cause both the nausea and the vomiting.

The simple distention of the stomach produced by warm water, an infusion of chamomile or mustard, the titillation of the fauces, are, each of them, sufficient to cause vomiting; but when an emetic substance, such as ipecacuanha or tartarized antimony, is received into the stomach, it is first absorbed and mixed with the blood, after which it produces nausea and vomiting, in the same manner as these substances do when injected into a vein.[1]

In these respects, the influence of emetic substances on particular portions of the cerebro-spinal system is quite analogous to that of some other medicinal substances, after their absorption and admixture with the blood, such as belladonna, strychnine, and chloroform; each producing its peculiar effects only upon one portion of the nervous system.

In contemplating, therefore, the effects of vomiting combined with nausea, we must consider its influence, both upon the stomach, and upon the sanguineous system.

Remedial effects of emetics in disorders of the heart.

The remedial effects of emetics in disorders of the heart are far more extensive, and their utility much greater, than, I believe, is generally suspected.

In those disturbances of the heart where the functions of the skin have been interrupted from exposure to cold, or the lungs affected from breathing cold air, thus causing a change in the balance of the circulation, the quantity of blood in the skin and in the extremities being diminished, there is a corresponding congestion within the great cavities, and especially in the left heart. In such cases, the violent convulsive movements produced by the action of an emetic enables the heart to send

They produce Diaphoresis.

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[1] John Hunter produced vomiting by injecting ipecacuanha into a vein. "An infusion of *ipecacuanha* injected into the vein of a dog produced sickness directly, even before I could suppose it could have reached the heart; and a scruple of *jalap* in infusion produced sickness and purging."—*Lectures*, p. 38.

an additional quantity of blood to the cutaneous capillaries, by which their circulation is restored, and heat and moisture are produced.

This effect of vomiting with nausea producing a change in the circulation of the cutaneous capillaries, has long been remarked; but pathologists never seem to have duly considered, that such a change in the capillary system was the effect of changes in the condition of the central organ; so that when inquiring into the curative effects of emetics, and into the influence which they produce on the system, little or no reference has been made to these changes in the heart—changes on which the condition of the capillary circulation must entirely depend.

Curative effects of vomiting in disorders of the right heart.

In affections of the *right* heart, remarkable benefit is derived from emetics, and their effects are evident on the *cerebral*, on the *pulmonary*, and on the *portal* systems.

In *venous* apoplexy, the good effects of an emetic in equalizing the circulation, and in restoring the balance between the arterial and venous systems, is well known: on the *veno-pulmonary* system, the effects of vomiting are equally remarkable. No less powerful is the influence of an emetic on the *portal* system. "I know no means," observes Cullen, "of expediting the circulation in the *liver* so powerful as that of vomiting."

Cullen's *Mat. Med.*

Exhibition of emetics.

There are no emetics more generally applicable to the treatment of the diseases of the heart, than ipecacuanha and emetic tartar.

Ipecacuanha.

A large dose of *ipecacuanha* operates quickly and empties the stomach, whereas, if two or three smaller doses be given at intervals of a quarter of an hour, a much greater impression will be made, and ulterior effects will be produced on the system. This accords with what has been mentioned regarding the difference in the effects of large and small doses of other medicines. By varying the dose of ipecacuanha, we can produce and prolong nausea to any desirable degree; or we can administer it in such doses as to cause vomiting. For these purposes, however, I have long been in the habit of combining the ipecacuanha with antimony, in the proportion of seven drachms of ipecacuanha to one drachm of antimonial wine.

Tartarized antimony.

The effects of the *tartarized antimony*, as a nauseating emetic, are in most respects similar to those of ipecacuanha; and its exhibition is particularly applicable to the treatment of disorders of the heart.

Consecutive effects of emetics, how to be relieved.

One or two hours after the operation of an emetic, a few grains of calomel put upon the tongue will be found to relieve a sensation of sickness, which is frequently caused by an inverted motion of the duodenum pouring some bile into the stomach. There is an uneasy state of the body, which often comes on after the vomiting and sickness have ceased; to relieve this, Sydenham was in the habit of giving an opiate.[1]

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[1] It has been pointed out by Magendie and Pelletier, that a weak decoction of "nut-galls" neutralizes the powers of *emetine*, and might be employed to stop violent vomiting from ipecacuanha.

CHAPTER XXXI.

GENERAL OBSERVATIONS ON THE REMEDIES EMPLOYED FOR THE TREATMENT OF DISEASES OF THE HEART.

THE CHEMICO-VITAL PROCESSES.

Organs by which the chemico-vital processes are performed; both the incretions and excretions are performed by the same organs; differences in organic and inorganic products; interchange in the functions of the organs of incretion and of excretion; transit of the incretions to the blood; discharge of the excretions from the body; nature of the incrementitious products; influence of medicines on the chemico-vital processes.

Organs by which they are performed.

The chemico-vital processes are performed by the *digestive*, by the *respiratory*, by the *cutaneous*, and by the *genito-urinary* organs.

The digestive, the respiratory, and the cutaneous systems are employed to absorb from the food, and to separate from the atmosphere, those elements which are necessary for life—the *incrementitious* products; they also separate, from the food and from the atmosphere, ingredients, the retention of which in the body would be hurtful—the *excrementitious* products.

"The manner in which nature acts consists, on one side, in attracting what is good and agreeable to each species, and in *retaining*, preparing, or changing it; and, on the other side, in *rejecting* whatever is superfluous or hurtful, after she has separated it from the good."

Hippocrates.

Both incretion and excretion performed by the same organs.

The same organs of each of these systems, which execute the incrementitious processes, also perform the excrementitious, except the kidneys and the uterus; yet, contrasted with one another, nothing can be more opposite than the characters of the incrementitious and the excrementitious products; for whilst some of those of excretion are "binary," and resemble inorganized compounds, such as carbonic acid, and phosphate of lime, which can be made in the chemical laboratory, those of incretion, which are at least "ternary," such as the chyle, cannot be imitated by the chemist.

"The chemical compositions of organic bodies are remarkable for the large number of different compounds, which are formed out of comparatively few elements, and also for their great proneness to decomposition."

Liebig.

There is, indeed, no more remarkable difference between the processes which are performed in the vital, and in the chemical laboratory, than in the length of time which is required by the chemist, to form some of those compounds, which are so quickly performed in the vital laboratory. "In nothing, indeed, do these processes differ from those of the chemist more than in the short time which is required to convert matters in the stomach into acid compounds, with the lengthened period which is necessary to produce in them a similar change when out of the body."

Paris's *Pharmacologia.*

Interchange in the functions of the different organs.

Besides the same organ being employed to perform the functions both of incretion and of excretion, another important arrangement is, that when the economy is disordered, by the imperfect mode in which any of the chemico-vital processes are performed, recourse is had to one or more of those organs which are healthy, to execute the functions of that organ which is deranged. Thus, the alimentary canal can execute the excretive office of the skin, the lungs, or the kidneys; the skin can execute that of the alimentary canal; the kidneys, that of the liver; and the gastro-pulmonary mucous surface, that of the uterus.

There are many substances, which, when taken into the stomach, or absorbed by the skin, escape by the lungs; the pulmonary exhalation contracting their odour,—as garlic, ether, and camphor. When there is only one organ destined to perform a particular function, if a portion of the organ is diseased, the bulk of the sound portion becomes enlarged, the better to enable it to perform the function; and where the economy is provided with a pair of organs, such as the eyes, the ears, the mammæ, the testes, and the kidneys, if one organ becomes diseased, and unable to perform its functions, the other enlarges and executes the office of both.

Composition of the incretions.

The incrementitious products are either fluid, or they are gaseous. The *fluid* are compounded from the aliment by the digestive organs; and they are also absorbed by the cutaneous lymphatics. The *gaseous* products are obtained in the lungs as well as in the skin by the decomposition of the atmospheric air.

Their transit to the blood.

The incrementitious corpuscles or atoms, derived from these two vital laboratories, are first either mixed or combined chemically with the venous, and then with the arterial blood; or some of them are conveyed by the vital stream, directly to the different organs on which they are destined to make their special impression; thus furnished with the elements of life, the arterial blood is distributed to the various organs, and by them it is converted into new compounds. In the treatment of the diseases of the heart, it is, therefore, essential to consider the condition of these incrementitious processes; for, as the qualities of the blood depend upon the products of these processes, every deviation from their healthy state must, more or less, influence the heart's functions.

Whilst the incretions pass into the blood, of no less importance is it, that the excretions should be discharged from the system.

"There are some juices or humours which, in particular cases, ought to be evacuated or drawn out of the body; and some others, that you ought to restore to the body, or cause to be produced therein."

Hippocrates.

Nature of the incrementitious products.

The *incrementitious* compounds may properly be said to contain all the elements of animal life; and after these compounds have been added to the blood, they are variously decomposed, and new products are formed each by different organs.

They contain the elements of combustion; of muscle and of bone; and of the cerebral pulp; and of the fluids.

Thus, in one of the vital laboratories, *combustion* takes place in order to produce animal heat; in another, the *muscular* fibre is eliminated for the purposes of locomotion and the circulation of the fluids; in one, *bone* is formed upon which the whole solid fabric is built, giving insertion to the muscles, and protecting the vital organs; in another, is produced the *cerebral* pulp, through the medium of which the vital powers act, endowing the various organs with their necessary sensibility; and, in another, the *fluids*, such as synovia, are compounded to serve the purpose of lubricating those surfaces which are required to move upon one another.

Importance of the chemico-vital processes.

In prosecuting our inquiries upon this subject, we shall find that there are medicinal substances, by the administration of which we are able to correct derangements in these processes. The incrementitious and the excrementitious processes become therefore highly interesting to the therapeutic inquirer ; for, whilst the condition of the body is influenced by any derangement in the functions of the organs which discharge from it those matters which are hurtful, in an equal degree is the health of the human frame interrupted by any irregularity or imperfection in the execution of those functions which supply it with the elements of nourishment. There is, indeed, no system of the animal economy which is more affected by any imperfection of these processes than the sanguineous; and it may be anticipated that changes in the qualities, or in the supply of the elements, which are necessary to repair the blood, will produce such changes in the vital fluid as will materially disturb the functions of the heart.

Their influence on the heart.

CHAPTER XXXII.

GENERAL OBSERVATIONS ON THE REMEDIES EMPLOYED FOR THE TREATMENT OF DISEASES OF THE HEART.

THE CHEMICO-VITAL PROCESSES OF THE DIGESTIVE ORGANS.

Dietetics: the proper quality and quantity of the food; regularity of the meals; stomachics; hepatics.

Influence of the processes of excretion and incretion on the heart.

THERE are no diseases more under the influence of the digestive apparatus than those of the heart; for not only is the blood greatly affected by derangements in both the incrementitious and the excrementitious processes, but the sympathy which exists between the digestive and the circulatory organs causes any imperfection in the functions of the organs of digestion to have a powerful influence on the heart. In the treatment of the heart's diseases we cannot, therefore, bestow too much attention on the means of remedying derangements of the digestive functions.

How these processes are remedied when disordered.

The animal economy employs various means to relieve imperfections in the functions of the alimentary canal, instinctively prompting us to partake of such aliments and drinks as will facilitate and improve the digestive process. We are also provided with medicinal bodies, by means of which each of the chemico-vital processes can be corrected; some of them assist in the assimilation of the food; some are absorbed and mixed with the blood; and others increase or diminish the excretions. Of these, the first may be appropriately classed amongst the *stomachics*, whilst the others are placed amongst the *purgatives and hepatics.*

Dietetics.

The incrementitious processes which are performed by the digestive organs may be said to commence in the mouth. There the food undergoes mastication, is mixed with the saliva, passes into the stomach, where it mixes with the gastric juice, and is converted into a homogeneous pulp or chyme. It afterwards passes into the duodenum, where it undergoes additional combinations; being there mixed with the pancreatic juice, the bile, and the excretion from the duodenum.

In this course the aliment undergoes various changes by the operations of the vital laboratory; the excrementitious portions are separated, passed off through the intestinal canal, and discharged from the body, whilst the *incrementitious* portions are absorbed and conveyed to the blood.

The important purposes which the incrementitious processes serve in the animal economy, point out the necessity of proper aliments to preserve the blood in a healthy state; and at the same time show the propriety of administering, in the diseases of the sanguiferous system, those medicinal substances which are known to preserve, or to improve the condition of the digestive organs, when these are deranged.

I have formerly remarked, how man, like the rest of the animal creation, is endowed with *instincts*, by which he is enabled to select the kinds of food and drink which are necessary for his sustenance; an instinct guides him in the selection of proper aliments in sickness, as well as in health. But these instincts not being alone sufficient for this essential purpose of the animal economy, we are provided also with the senses of *taste* and *smell*, which are so placed that they perform the duty of sentinels, guarding the stomach, and preventing it from receiving any improper food, which, guided by instinct alone, we might not have rejected.

"Hence the adorable Creator has conjoined the uneasy sensation of hunger and thirst, and has at the same time ordained, that a pleasure shall be perceived by people when they take food to allay their hunger or drink to quench their thirst." Boerhaave.

Animals try their food by the sense of smell before they take it into their mouth, and by the taste before they swallow it.

"On dissecting a goat with young, Galen found a brisk embryo, and, on detaching it from the matrix, and snatching it away before it saw its dam, took it into a room where there was vessels, some filled with *wine*, others with *oil;* some with *honey*, and others with *milk;* and others with *grains* and *fruits*. It smelt every one of these things, and when it had smelt them all, *it drank up the milk*."

Darwin's *Zoonomia.*

Further, it appears to be a law of the animal economy, that these instincts and these senses shall obey and be subservient to the varied conditions of the body; that the food which is most grateful when in health, shall be rejected in sickness; and that food which is unpalatable to those who are in health shall be agreeable to the sick. When, therefore, we contemplate the digestive process, that function where it is not improbable the agency of the *vital* principle is first developed, and when we inquire into its disordered states, and the means of relieving them, we are then led to seek for those therapeutic means by which we can imitate or assist that important process.

So intimately, indeed, are the functions of the heart associated with those of the digestive canal in the healthy state of the body, that we need not be surprised that a disordered heart is powerfully influenced by disturbances in the digestive apparatus. Hence we shall find that there is no disease of the heart, the symptoms of which are not aggravated by a derangement of the digestive organs; and also that there are many disorders of the heart which are caused alone by disorders of the digestive organs.

Though man, like the rest of the animal creation, is endowed with an instinct, and the senses of taste and smell, to guide him in the selection of his food, it must also be borne in mind, that the instinct is under the influence of his *will*, and consequently that from the habits of civilized life, and the various culinary arts which have been contrived to increase our animal gratifications, the digestive organs are subject to a variety of disorders.

But it is not the uneducated classes of the community who are the greatest slaves to, and the most severe sufferers from, sensual gratifications. In proportion as man becomes refined, he studies and practises the "gastronomic" art; so that in the practice of medicine amongst the polished and the learned, the physician finds his advice little sought for if he endeavour to check them too rigidly in their animal propensities.

Food either of an improper quality, taken at irregular meals, or in an improper quantity, will, by deranging the stomach, more or less aggravate all the symptoms of a disordered heart; and, therefore, each of these points deserves attention, in regulating the diet of those suffering from a disturbed circulation.

The proper quality of the food.

With regard to the *quality* of the food, most persons are perfectly aware of those kinds of food which they cannot easily digest; so that all such aliments should be avoided, and those only partaken of which experience has taught them to be of the most easy digestion.

Animals can, by gradual habit, live upon food that is not the natural aliment of their species; and so man, in various parts of the globe, lives upon very different kinds of food. I have long been accustomed to direct the sick always to partake of the kind of aliment which they most desire; for it is impossible from any appearances of the tongue, of the skin, or of the pulse, to dictate to the inclinations and tastes of different individuals. We constantly observe that persons recovering from a severe illness, or suffering from some chronic derangement of the digestive organs, express a great desire for some particular kind of food, and often for such as they dislike when in health. I have never had occasion to regret recommending to the sick this rule of choosing their own aliment; provided always that the food or drink was not suggested by any person to the patient, and that it was taken only in a *moderate* quantity. Where an opposite rule is followed, especially in those suffering from diseases of a febrile type, in which the heart is much excited, if animal food, particularly in a solid form, be given, it seldom fails to aggravate all the febrile symptoms; and instances are not very rare in which fatal effects have resulted from a patient eating even a small quantity of animal food, either during, or when apparently recovering from diseases of an inflammatory character.

Baillie's *Posthumous Works.*

Most practical men are aware of the pernicious effects, which often follow the too early use of animal food, by those who have suffered from any disease of an inflammatory character. Dr. Baillie "never observed a person having a relapse of fever where it had not been caused by eating animal food." This pernicious effect of convalescents taking animal food too early, is frequently observed in women, who are induced to partake of it before the excited condition of their frame has recovered from the effects of child-birth.

The effect of animal food, in the cases here alluded to, is satisfactorily explained, by observations made on a man who, from an accident, had a permanent opening made, through the abdominal parietes, into the stomach, sufficiently large to permit the internal surface of the stomach to be seen. When he was feverish, the mucous surface of the stomach was less vascular and dry; and animal food remained a long time in it undigested, causing more or less uneasiness. *New York Med. Repos.*

A large proportion of the inhabitants of this country live on an admixture of animal and vegetable food; and it is considered, that those who are obliged to live on vegetables, are not able to endure the same muscular exertions, as those who partake of a proportion of animal food.[1]

In regulating the quantity of food, it may be well to notice, that if all the food received into the stomach be digested, it may yield too much nutrition for the support of the body; such superabundant nutriment becomes an element of disease. Hence a common error in regulating the diet of the sick, of giving them not only too much food, but food which is considered the most nutritious. Jones.

Cases.

Wellington, who had always previously lived abstemiously, lost his life by partaking of an unusually large meal, which his stomach was unable to digest.

Several persons, who were burnt at the fire in Covent Garden, and admitted into St. Bartholomew's Hospital, when fast recovering had a quantity of animal food sent to them, in consequence of eating which, consecutive fever came on, and they all perished. Abernethy.

In conclusion, I may remark, that this rule for regulating the diet of the sick is in accordance with what we observe throughout the animal kingdom; all animals, when suffering from disease, select particular kinds of food, and often such food as would be hurtful to them when in health. Thus, many animals, under particular circumstances, eat substances to cause vomiting or purging; at other times they resort to salt springs, or to the sea-shore.

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[1] "Il est certain que les grands mangeurs de viande sont en général cruels et feroces plus que les autres hommes. Cette observation est de tout les lieux, et de tous les temps: la barbare Anglaise est comnue," &c. &c.—Emile des Rousseau.

The proper quantity of of food.

In regulating the diet, it has long appeared to me, that the chief point to inculcate, for the guidance of the sick, is moderation in the *quantity* of food which is taken at each meal. The palate may seldom fail to be a safe guide for selecting the proper quality of food, but most persons require to make an effort to limit the quantity of a meal, and to avoid eating to repletion; for if a meal be moderate, any disordered state of the heart will suffer little from the condition of the stomach. It is essential to discriminate between the quantity of food which is required for the maintenance of life, and that quantity taken merely as a source of sensual gratification. "I have often heard Napoleon say," observes his biographer, "that however little nourishment people took at dinner, they always took too much. Thus the Emperor's head was always clear and his labours easy, even when he rose from table."

Bourienne.

Such is the influence of digestion upon the circulation, that the vigour of the mind, as well as that of the physical frame, is greatly diminished by over-indulgence in food; and those whose mental avocations are intense and laborious, or whose bodily exertions are great, are never able, without more or less suffering, to indulge in habits of repletion.

The effects of *abstinence* are observed in those suffering from ailments, wherein the stomach cannot retain food: it is astonishing on how little food life can be sustained; of this the histories of shipwrecked sailors and of soldiers on active service, afford many proofs.

Case.

A lady, who had a tumour in her breast, was told that if she would live upon one pint of water a day for a lengthened period, the swelling would be absorbed; but, after doing so for six weeks, the swelling did not disappear: her health was not injured, though her strength was greatly diminished.

"In many diseases," observes Liebig, "substances are produced, which are incapable of assimilation. By the mere deprivation of food, those substances are removed from the body without leaving a trace behind; their elements have entered into combination with the oxygen of the air." Further, "through the skin and the lungs there escapes a certain quantity of water, and as the presence of the water is essential to the continuance of the vital motions, its dissipation hastens death. Cases have occurred, in which a full supply of water being accessible to the sufferer, death has not occurred till after the lapse of twenty days. In one case life was sustained in this way for the period of sixty days." Liebig.

The meals should be regular.

Besides attention to the quantity of the food, the *regularity* of the meals is of great consequence; of this every one is aware from personal experience. The number of meals, and the time when they are made are very different with different persons; such differences do not appear to interfere with the enjoyment of health. But any irregularity, and, above all, taking even a very small portion of food between the accustomed meals, is often the cause of greatly disturbing digestion; and as the desire of food comes on at the usual period of the meals, if it be not taken when the stomach has made the requisite preparation for its reception, digestion becomes always more difficult and often very imperfect.

Medicines improve the incrementitious processes,

However strict may be the attention paid to select and limit the quantity, as well as to regulate the periods for taking food; yet from habit, and also from the numerous maladies to which man is liable, it often happens that the digestive function is impaired, and that it can be materially improved by the administration of appropriate medicines.

Let us proceed next to the consideration of those medicinal substances which assist the digestive processes, and which extract from the aliment those products which are to be absorbed and conveyed to the blood; and likewise to those medicines which pass from the digestive canal to the blood unchanged, where, by their presence in the vital stream, they produce curative effects on the disorders of the heart.

These medicinal substances may be appropriately classed amongst the *stomachics*, the *hœmatics*, the *neurotics*, and the *absorbents*. Each of these classes merits a separate consideration.

Stomachics.

When medicinal substances are received into the stomach, and their different modes of action.

they are either simply mixed with the food or they undergo changes in the vital laboratory, and are formed into new compounds with the contents of the stomach; some of which are afterwards absorbed and mixed with the blood; others pass through the alimentary canal, without being changed in their qualities, or diminished in their quantity.

Their utility in the treatment of diseases of the heart.

The phenomena that are manifested in these different modes by which medicinal substances act upon the *primæ viæ* are extremely interesting, and enable us to adopt certain principles, in order to regulate the treatment of disease; as there is no class of ailments, where such principles can be so aptly applied as in the treatment of the diseases of the sanguineous system.

Hunter.

The stomach may justly be considered as the "centre of sympathy," when we reflect on the extraordinary influence which the *ingesta* exercise upon the system: for whatever is received into the stomach, either in the shape of food or medicine, has, doubtless, a direct action upon its tissues, however various may be the subsequent effects produced on other organs.

General laws to be observed in the action of medicines.

This leads me further to observe with regard to medicinal substances, that the more successfully the phenomena of the animal economy are explored, and the more attentively the effects of medicines upon the different organs are observed, the better are we enabled to trace these effects to some general laws. However numerous and multiplied be the facts which empiricism has furnished, and however unsuccessful therapeutic inquirers may have hitherto been in revealing general principles, by which medicinal substances produce their varied influence upon the economy, I am fully persuaded, that both physiological and chemical science have already advanced far enough to enable us, by legitimate induction, to explain certain *laws* which are established in the animal economy; under the control of which medicines, as well as aliments, act upon the body.

These laws defined.

First, One of these laws seems to be, that every medicinal substance has its influence upon one organ, or upon one system of organs.

Second, That by whatever channel medicinal substances are conveyed to the blood, their effects on particular organs or systems are always the same.

Third, That medicinal substances act, not only on particular systems of the economy, but that some medicines contain several distinct ingredients, each of which acts upon a separate system or portion of a system.

Now these laws of the economy are illustrated and fully confirmed by a multitude of phenomena.

Medicines upon one organ.

That every medicinal body acts upon a particular organ, or on a particular system, is a fact universally established, and on the knowledge of which is based the science of therapeutics. That medicinal substances not only act upon one system, but upon different portions of a system, the cerebro-spinal affords an excellent illustration ; neurotics, properly so called, affect each a particular portion of the cerebro-spinal and ganglionic systems. Opium acts upon the brain ; chloroform upon the sensory; and strychnine upon the motor column of the spinal cord.

Their analogy to the phenomena of disease.

I may repeat the observation, that this law, in regard to the special effects of medicines, is strictly analogous to the phenomena of diseases : these usually affecting a particular system, or a particular portion of that system.

Thus, we have seen, that not only each of the different systems of the economy, but even different portions of these systems, may be separately affected by derangements of the circulation ; striking examples of this I have already given,—as, when different portions of the cerebro-spinal system are affected when the heart is diseased.

This striking analogy of the influence of medicinal substances to the phenomena of disease is of great value, as it points out a rational method, both for the arrangement and for the administration of the various substances of the *materia medica*. The practical importance of this will appear, when considering the effects of medicines, in the treatment of the numerous diseases of the heart.

And where-ever they are applied.

The second law,—that medicinal substances produce similar effects, whether they enter the blood by the absorbents of the alimentary canal, or by the pulmonary, or by the cutaneous absorbents ; that their effects are the same, by whichever of these portions of the absorbent system they may have been conveyed to the blood,—is shown by some of the most powerful therapeutic agents. *Arsenic*, whether it be taken into the stomach, applied to the skin, or to the surface of an ulcer, produces precisely similar effects; inflaming the mucous membrane of the stomach and rectum, and leaving unaffected the intermediate portion of that tunic of the intestinal canal. *Tobacco*, *chloroform*, and *ether* produce similar effects on the circulation, whether they be taken into the stomach, inhaled by the lungs, or absorbed by the skin; *cantharides* causes stranguary, and *emetic tartar* nausea, whether taken into the stomach, or applied to the skin.

There are also *purgative* medicines, which act upon the alimentary canal, whether they may have been absorbed by the skin, inhaled by the lungs, applied to the tongue, or received into the stomach; and it matters not whether *mercury* be swallowed, absorbed by the skin, or inhaled by the lungs, in order to cause salivation; nor whether *belladonna* be swallowed or rubbed upon the skin to produce its specific effect upon the iris. It is the same with *opium* and *strychnine*, their medicinal effects being produced, whether they be swallowed, inhaled, or applied to the cutaneous surface. To conclude, I may observe, in evidence of this law of the economy, that the same effects are produced by injecting *emetine* into the cavities of the pleura, and into the parenchyma of different organs. Magendie.

Stomachic medicines.

The stomach may not be inaptly considered as a central laboratory, in which is performed both incrementitious and excrementitious processes, and from which the products of both these processes are removed; the one being conveyed to the blood by the absorbents, and the other discharged from the body by the intestinal canal.

Stomachic medicines, properly so called, are those substances that act either directly upon the tissues of the stomach, or which, when mixed with the food and assisted by the operations of the vital laboratory, render the food more easily convertible into chyle; as the condition of the whole animal frame greatly depends on the manner in which the incrementitious processes are performed, stomachics will therefore be found an important class of remedies in the treatment of some of the diseases of the heart.

These medicines have been classed amongst the *tonics* and *astringents*; some amongst the *carminatives*; others amongst the *aromatics;* some amongst the *corroborants;* and some amongst the *anti-spasmodics*, thus affording another proof of the unphilosophical methods which have been contrived to classify the various objects of the *materia medica*, and to arrange them according to some theoretical opinion of their modes of action upon the animal economy.

When medicinal bodies are received into the stomach, whether they be mixed with its contents, and form with them new compounds—whether they be conveyed by the absorbent vessels into the blood—or whether they pass through the intestinal canal unchanged, the specific effects of each are produced by their influence upon the different tissues of the stomach. Some act upon the vascular; some upon the absorbent; and some upon the nervous tissue of the stomach; others appear to act upon the mucous and the muscular coats; whilst those medicines, which are absorbed unchanged and mixed with the blood, influence the functions of the heart, either by coming into direct contact with the lining membrane of its cavities, by entering into its structures through the cardiac arteries, or by their influence upon the whole, or only upon a portion, of the cerebro-spinal system.

There are certain medicinal substances, such as the *vegetable acids*, the *alkalis*, and some saline compounds, such as the *muriate of soda*, which, whenever they enter the stomach, form compounds, chemically mixing with the food, by which they render its assimilation more easily performed, or by which they form new compounds to be mixed with the blood. But how far either medicinal or alimentary bodies act directly on the tissues of the stomach, or are first absorbed by the blood, many discrepant conjectures have been made. That they must cause certain changes, on the tissues of the stomach, appears, however, probable from the almost instantaneous effects which some of them produce, and from the sensations which they create, not only in the stomach itself, but throughout the whole system. There are analogous examples of the action of medicines upon other organs when directly applied to them; such as the effects of collyria, and of injections into the intestines, the urethra, and into the vagina.

" That *medicines* showing considerable powers with respect to the whole system, act especially or only on the *stomach*, will appear from all those cases in which the effects are seen soon after the substance has been taken into the stomach, and before they can be supposed to have gone further into the body, or to have reached the mass of blood."

Cullen's *Mat. Med.*

Those substances which enter the blood must, undoubtedly, in the first place, produce certain effects on the tissues of the stomach, more especially upon its absorbents. On the other hand, there is no doubt of the rapidity with which substances taken into the stomach reach the heart; and when we consider the velocity of the blood's stream, it is easy to explain how quickly any particular organ may be influenced through the medium of the blood by such medicinal bodies as act upon it.

As has been said, those medicines which act upon the coats of the stomach do not make their impression upon all of them indiscriminately, but each appears to produce its effects upon one particular tissue. Thus some act upon the mucous, some upon the capillary, some upon the absorbent and muscular, and some upon the nervous tissue; so that various effects are produced by medicinal substances when received into the stomach, one causing an increase, and another a diminution of the vigour of the capillaries; another increasing or subduing the mucous secretions, and another making an impression upon the gastric nerves.[1]

Those medicines whose action appears to be limited to the stomach, and which pass through the alimentary canal without being diminished in quantity or changed in quality, are the *tonics* and *astringents;* consequently, in the disorders of the circulation, which are symptomatic of an impaired digestion, or in those disorders which are aggravated by it, the use of stomachics is essential for their relief. At the same time, in the treatment of some of the diseases of the heart, this class of remedies will often prove injurious, and great discrimination is therefore necessary in administering them.

The most powerful vegetable tonics contain both a *bitter* and an *aromatic* element, and of these none are more useful in assisting digestion than *hops* and *aloes*. Animals as well as man, are instinctively impelled to eat particular substances when they are not in health, in order to assist the digestion of the food; and "no cattle will thrive upon grasses which do not contain a portion of bitter extractive." Even the inhalation of the odour from the flowers of the hop has an extraordinary beneficial effect upon the sick. In Kent, where hop is extensively cultivated, those employed in collecting the flowers are often so greatly improved in their health, that many persons, who are enfeebled, quit the metropolis to "pick hops," and return to their homes with their appetite and strength materially improved.

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[1] The Chinese allege that they have numerous *stomachs*—one suitable for each kind of food they have partaken of at one meal. And so there may be a stomach for each particular medicine. Certain it is that the action on the alimentary canal of croton oil, of calomel, of jalap, of senna, of rhubarb, and of antimony, are all perfectly different.

Paris's *Pharmacologia.*

The salutary as well as the injurious effects of those vegetable substances, which contain the astringent principle, are illustrated in the use of *tea* and of *coffee;* a moderate quantity of either improving digestion, while a larger disturbs the heart—causes restlessness and prevents sleep. The injurious effects of tea, however, seems to depend chiefly on the quantity of *tanine* which is contained in the infusion; for if the leaves have been infused only a sufficient time to extract the *theine*, and none of the *tanine*, then no injurious effects are produced on the general circulation. But *coffee*, as it is usually prepared, always contains, besides *caffeine*, a certain quantity of *tanine*, and it is this bitter ingredient in the coffee, particularly when taken at a late hour, which so frequently disturbs the heart and causes wakefulness; whereas, when coffee is taken after a meal, in a comparatively small quantity, and without milk, then acting as a stomachic, it assists the digestion of the food.

Napoleon, we are told, took daily no less than twenty-five cups of coffee. This he was enabled to do with impunity, by the mode in which the coffee was prepared. "Two ounces of coffee were used to make one cup; on this quantity was poured cold water, very slowly, till all the liquid had traversed the coffee; the liquid was then warmed and drunk. Science has ascertained that cold water separates from the coffee its aromatic and exhilarating elements; whereas the bitter and indigestible elements remain in the dregs, as these are not soluble, except in hot water."

Journal de Médecine.

In those suffering from affections of the heart, both tea and coffee are to be made use of with caution:[1] there are many instances of persons, whose heart has been greatly disturbed, and who have been completely relieved merely by discontinuing these beverages.

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[1] It has been ascertained that *caffeine* and *theine* contain the same element.

On the other hand, it sometimes happens, though rarely, that a disordered circulation has been relieved by their use. "A young lady had violent nervous palpitations; finding that the usual remedies had been prescribed without any relief, I suggested that a strong infusion of *green tea* should be given three or four times a day, and continued for a few days; relief followed, and perfect recovery in two or three days."

Case recorded by Copeland.

These remarks on the effects which are produced by the use of tea and coffee upon the heart's action, are strictly applicable to other vegetable tonics and astringents; and likewise to the preparations of iron, copper, and lead. These medicinal substances are not only absorbed from the alimentary canal, and conveyed to the blood, as we see exemplified in the treatment of many diseases of the circulation where the qualities of the blood are changed, but they also act as tonics or astringents upon the tissues of the stomach.

Nothing is more remarkable than the difference in the effects of these various remedies upon persons who have an irritable heart, and upon those whose circulation is languid from the heart being unable vigorously to propel the blood. In the first description of cases, tonics, in place of tranquillizing, increase the heart's action; and it is not unusual for patients, however greatly their general health may be enfeebled, to remark that they cannot bear any description of *tonics;* all such medicines causing heat of the skin, flushing of the face, and general restlessness. Those of an opposite temperament, on the other hand, and in whom both the cardiac and arterial pulse is feeble and languid, have their health improved by tonics and medicinal substances that contain *bitter extractive*.

Carminatives.

In disturbances of the heart, it is always of importance to relieve any over-distention of the stomach, for such is its relative position to the heart, that when replete, it interrupts by its pressure the heart's movements, and the more so when an attempt is made to lie in a horizontal position.[1]

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[1] Hale remarks, that "the flatulent are often subject to *vertigo* from the wind distending the gullet, and pressing upon the descending aorta, whereby the blood is driven too forcibly to the superior parts."

To relieve flatulency *carminatives* are usually resorted to, such as *peppers* or *ginger*, either taken singly or combined with *rhubarb*, and taken immediately before a meal; or the *galbanum* pill, with or without aloes, often greatly assists the digestive process.

The influence of the mind, aiding and interrupting digestion, ought never to be disregarded. "Cheerfulness, moral satisfaction, and mirth, have an influence on the heart, and favour digestion. Great eaters are seldom accessible to grief; and who has not remarked the influence of digestion on the state of the mind?" Magendie.

Hepatics.

No sooner has the stomach separated from the food certain of its elements, and formed with them new compounds, which are absorbed and conveyed to the blood, than the remainder of the aliment passes into the intestinal canal, where it is mixed with the pancreatic juice, the *bile*, and secretions from the mucous membrane of the intestines.

Whether the liver be considered as an organ of secretion or of excretion, there is no doubt of the influence of a derangement of its functions upon the heart; and whether the *bile* is not duly secreted from the blood, or whether, after it has been separated from it, and again absorbed and mixed with the vital fluid,—when any of these changes take place, the vigour of the heart's action is then more or less diminished; so that there is a corresponding loss of power in the muscular system, and in the energy of the intellectual powers. Whatever be the chemico-vital processes which take place in the blood, during its passage through the liver, it is quite certain that there is excreted from it a liquid, which, when mixed with the ingesta, as they pass through the duodenum, materially assist in chylification; and by a diminution of which, or by a change in its qualities, there is more or less disturbance in the digestive process.

Derangements in the functions of the liver have always been considered as frequent causes of disease, and to those suffering from such ailments has been assigned the *bilious* temperament.

The vascular connexion between the heart and the *portal* system accounts for the derangements in the biliary functions; for, as there is, in the diseases of the heart, an assemblage of symptoms from disturbances in the portal circulation, to subdue these becomes therefore an important curative indication.

Other disturbances in the heart arise either from the bile not being discharged into the duodenum; from its being absorbed into the blood after having been secreted; or from morbid changes in the qualities of that fluid.

When the biliary secretions are interrupted, other excretive organs, such as the skin, the lungs, and the kidneys, will then assist in performing that function of the liver; but when these separate processes of the economy are inadequate to separate from the blood that ingredient which the liver was incapable to excrete, the necessary assistance may then be afforded by the agency of those medicinal substances, which act specially upon the chylopoietic viscera, or by those which increase the other excrementitious processes, more particularly the skin and the kidneys.

Particular hepatic medicines.

Besides mercurial and antimonial preparations, the mineral acids, the alkalis, ipecacuanha, and rhubarb, are all medicines which, when given singly or combined, experience has shown to have a decided action upon the liver.

Effects of mercury combined with other medicines.

For the same purpose, *mercury* may be given combined with *antimony*, opium, hyosciamus, conium, digitalis, or other neurotics; by all of which the effects of the *mercury* are variously modified.

In many cases *opium*, combined with calomel, has a most beneficial effect on the biliary organs, and can be freely used by persons with whom either of these medicines taken singly does not agree. In fact, we produce entirely new effects by combining calomel with neurotics.

No less valuable are the effects of combining mercurial preparations with those of *antimony;* calomel and the tartarized antimony, or James's powder, combined, not only change the biliary secretions, but increase the excretions of the cutaneous and of the gastro-pulmonary mucous membrane.[1]

The use of mercurials

The specific effects which mercury produces on the circulation are of great value in the treatment of many diseases; but these effects are equally injurious in certain conditions of the heart.

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[1] The combination of calomel with the sulphuret of antimony was first introduced into notice by Dr. Plummer, since which time it has preserved a high reputation. See the *Edinburgh Medical Essays and Observations*, 1733.

In relieving inflammatory affections of the different organs, mercury has a most decided influence; but, as has been mentioned when speaking of the causes of the disorders of the heart, mercury was one of those substances which not unfrequently produced disturbances in the circulation by poisoning the blood; and some cases are on record where it became the source of fatal disease. The influence of mercury upon the circulation, when exhibited in disorders of the heart, should therefore be carefully watched; the mode of administering it for restoring the functions of the liver, when such derangement is accompanied with a disturbance in the functions of the heart, requires much nicety,—the difficulty in many cases being to relieve the liver without injuring the heart.

Edin. Med. and Surg. Journal. vol. xiv.

To fulfil this purpose, much depends both upon the quantity of each dose, the frequency of its repetition, and upon the mode in which the medicine is combined with other medicines.

Effects of different doses of medicines.

As to *quantity*, I have already remarked how fallacious it was to estimate the effect of a medicine by the quantity which is given; or to pretend to calculate, that the effects will be increased or diminished according to the increase or diminution in the quantity.

Mercury may be administered in the diseases of the heart, as in the diseases of other organs, in a variety of forms—calomel, blue pill, or the mercury with chalk; it may be either taken internally or absorbed by the skin, according to the particular circumstances of each case.

A large dose of calomel will generally act as a sedative, whilst a very small quantity will purge the bowels. At other times the large dose of calomel will empty the gall-bladder of a quantity of vitiated bile; whereas the small dose will be absorbed and mixed with the blood and affect the organs of circulation; rendering the heart irritable, and creating what is usually called mercurial fever. Hence large doses of calomel may be often safely administered to those who have found great disturbance of the nervous system from a small dose; and in all inflammatory affections, where it is desirable that the system should be affected with mercury, *ptyalism* is more quickly produced by small doses, frequently repeated, than by an equal quantity given in large doses. It is also worthy of notice, that when mercury is given, to relieve inflammation to a person, who, under other circumstances, may have suffered great uneasiness from even a small quantity of it, he can now reap essential benefit from its effects in relieving the inflammation; and it usually happens in such cases, that when the inflammatory symptoms are subdued, the mercury, if continued, creates poisonous effects upon the heart.

In conclusion, it may be remarked, that when, from whatever cause, the mercurial or antimonial preparations have not been sufficient, either to subdue the derangement of the hepatic system, or that it has been advisable not longer to administer them, it will then be expedient to employ the mineral *acids*, either taking these internally, or applying them to the skin; *rhubarb* also, in small doses, may be given, combined with *soda*, castile *soap*, or *ipecacuanha*.

Purgatives.

During the transit of the aliment through the intestinal canal, a succession of chemico-vital processes take place; some of the products of which are absorbed, and conveyed to the blood, whilst others, which are excrementitious, are discharged from the body.

The changes in the quantity and qualities of the alvine evacuations have been always considered an important symptom of diseases;[1] and though these may be considered to be periodical when digestion is perfect, yet their regularity, as well as the quantity and quality of the excrements, are often variously altered.

Purging a curative process.

Of the excrementitious processes, purging is frequently employed as a curative process by the animal economy, and it is one which we have ample means of imitating by therapeutic agents.

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[1] All *excrements*, of what nature soever, that are separated from the body of man, furnished also Hippocrates with signs, from which he drew many consequences. He made no difficulty at all in examining into the urine, the stools, the flatulency, the sweat, the hawkings and spittings, the mucus of the nose, the tears, the filth of the ears, the purulent matter of ulcers, as materials from whence he drew signs that gave him the greatest certainty in relation to the quality of the humours.

Different effects of purgatives.

In the use of purgatives for the treatment of disorders of the heart, it is of great practical importance to consider, whether it be necessary to purge, or merely to *evacuate* the bowels; two processes, essentially differing in some respects, though each effect may be produced by different doses of many medicines.

In many diseases, the mucous system of the digestive canal secretes from the blood fluids which are hurtful to the body, or the liver discharges vitiated bile; processes which nature employs for the cure of diseases, and which were considered by the elder physicians as indicating a *crisis*,—hence the danger of checking a critical purging.

These two conditions of the alimentary canal, evacuation and purging, satisfactorily explain the differences in the effects of cathartic medicines, and also the causes that have led them to be divided by Cullen and others into mild and drastic; laxative and purgative; aperient and cathartic; for the same medicine may either have a purgative or a simple evacuating effect, according to the quantity or the circumstances, in which it is administered.

Daily experience teaches us that purgatives may often be employed to a great extent, and continued for a lengthened period without much benefit, until finally some feculent matter is evacuated; immediately after which all the symptoms of a disordered heart are alleviated.

They act upon particular portions of the alimentary canal.

Purgatives act upon different *portions* of the digestive canal; some upon the stomach; some upon the duodenum; some upon the small, some upon the large intestines, and others upon the rectum; so that in the administration of this class of medicines it is essential to discriminate the portion of the canal which requires evacuation, the more so, as that medicine which acts upon one of these portions has no effect upon the others.

The particular effects of different purgatives.

Thus saline medicines act upon the mucous membrane of the stomach and small intestines; mercurials upon the salivary and hepatic secretions, and aloes upon the colon and the rectum.

Illustrated by analogy.

This action of medicines upon particular parts of the alimentary canal is perfectly analogous to what is observed of other medicinal bodies, which act only upon particular portions of other systems, and which is so remarkable in *neurotics;* medicines properly belonging to that class affecting only particular portions of the cerebro-spinal and ganglionic systems.

It is also a curious and interesting law, with regard to the effects of medicinal substances, that on whatever organ their medicinal powers act, it matters not how, or by what channel the medicine enters the system. This is the case with purgatives, many of which act upon the alimentary canal, whether applied to the tongue, absorbed by the skin, or inhaled by the lungs.

Co-operation in the functions of the organs of excretion.

As the different excretory organs—the skin, the alimentary canal, the lungs, the kidneys, the liver, and the uterus—all co-operate with each other in discharging from the body those matters which are superfluous or hurtful: in estimating therefore the condition of any of these organs, we must take into consideration the state of all of them; for, as in health, so we find their functions constantly varying in disease. Thus, the excretions from the intestines are diminished, when either the perspiration, or the discharge of urine is increased; and when perspiration or the flow of urine is diminished, the alvine discharge is increased.

Case.

Further, to show the remarkable interchange which sometimes occurs in the excretory organs, and to what an extent constipation may happen without the bowels being overloaded with excrementitious matter, I may mention the case of a lady who for six weeks before her death had no alvine evacuation. On inspecting the body, I found that an obstruction had been occasioned by the long neck of a tumour of the uterus, somewhat resembling a portion of umbilical cord, which had entangled and strangulated the intestine; and that instead of a congestion in the alimentary canal there was found but a very small quantity of a dark yellow inodorous matter contained in the intestines.

Good's *Study of Medicine.*

"A girl fourteen years of age, in whom the anus and the *meatus urinarius* were imperforated, discharged regularly the urine by the nipple, and the fæces by vomiting."

Practical inferences.

This interchange in the functions of the organs of excretion is not only an interesting physiological fact, but there may be drawn from it an important principle for the treatment of the diseases of the heart, as it points out the necessity of regulating these excrementitious processes, by administering such medicinal bodies as will restore the functions of whichever of the organs is disordered; and also the propriety of increasing the excretions of the other organs which the economy may require.

Irregularities in the alvine evacuation.

An accumulation in the large intestines does not, however, in all cases, take place from irregularities in their evacuation; for although most persons in health have an alvine discharge every twenty-four hours, yet there is often an irregularity in this, as in all the other excrementitious functions; there being great differences not only in the interval between the evacuations, but likewise in the quantity of excrementitious matter which is discharged.

In some families the bowels are evacuated every other day; and we constantly meet with persons, who, whilst they are in the enjoyment of health, have an alvine evacuation only once every three, four, five, or six days.

Cases.

A lady who lived and enjoyed good health till her eighty-third year, had the bowels moved generally once in three weeks throughout most part of her life. But the most extraordinary instance I ever met with, was that of a lady who enjoyed excellent health, the mother of six children, and whose bowels had been opened only once a month since the first appearance of the catamenia; the alvine evacuation took place in the most regular manner, always in the morning of the same day on which the catamenia made their appearance. Similar cases are recorded in medical writings.

The symptoms which arise from the presence of excrementitious matter in the different portions of the alimentary canal, afford additional evidence of the differences in their functions, and also of the specific effects of particular medicines on these different portions.

Hamilton *On the use of Purgatives.*

Nothing is more remarkable than the influence of a retention of feculent matter in the large intestines, and in the lower part of the *rectum*, upon the heart. Excrementitious deposits in the colon, it is well known, sometimes exist for a very lengthened period, before they create any decided symptoms; but when the daily alvine evacuation is interrupted, and the usual effort is unable to produce it, the retention of the feculent matter in the lower portion of the rectum deranges the circulation, and causes more or less disturbance throughout the whole system.

Case.

A lady, after having had an abortion, suffered a good deal of febrile excitement; four weeks after that event there continued a very profuse vaginal discharge, with local pain, a quick irritable pulse, hot skin, thirst, loss of appetite, a dark brown furred tongue, and notwithstanding that attention had been paid to regulate the bowels, a piece of feculent matter, described to me "to be of the size of, and as hard as, a billiard ball," was evacuated with great difficulty—immediately after which all the local and general symptoms disappeared.

Case.

A housekeeper, who had eaten some *cake*, about five weeks afterwards complained of a very distressing pain in the rectum, the cause of which could not be ascertained. At the end of the sixth week the bowels were evacuated, with great pain and difficulty, of a large and very solid mass, in the centre of which was a portion of the cake; immediately afterwards every symptom vanished.

Importance of the alvine evacuation.

The salutary effects of regularity in the alvine evacuation are so generally known and appreciated, that the Chinese, when they accost each other, in place of inquiring, as is the custom in this country, after the health, they merely inquire what is the state of the bowels; concluding, that according as they have or have not acted, so must be the feelings of comfort or discomfort.[1]

Whatever additional treatment may be required to improve or remedy any disordered state of the digestive apparatus, it is of primary importance for all those who have a disordered heart to avoid constipation, and never to permit the contents of the large bowels to accumulate in such a manner as to require any great expulsive effort for their evacuation.

The use of enemas and suppositories.

The *enema* and the *suppository* are also of essential use; their primary effect being to unload the large bowels, especially the rectum.[2]

In many instances of diseased hearts, the patients have expired whilst in the act of evacuating the bowels. This, I have mentioned, was the fate of Abercrombie, a fissure being found after death in the right auricle.

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[1] "Voltaire n'a jamais demandé une faveur à quelqu'un, sans s'informer d'abord, à son valet-de-chambre, si il avait été le matin sur la chaise percée."

[2] "The *Ibis*, a bird in Egypt, which was worshipped by the ancient inhabitants, when it was sick, used to inject, with its long bill, the water of the Nile into its fundament; whence, Longius writes, they learned the use of *clysters*."—Buffon.

Caution in the use of purgatives.

The use of purgatives for evacuating the feculent contents of the large bowels, and for increasing the secretion of the upper portion of the alimentary canal, as essential parts of the depletive system, are universally acknowledged; but when purgatives are too much employed, injurious effects may supervene. This leads me to observe, with regard to the use of purgatives in the diseases of the heart, that however important may be the free employment of certain purging remedies in those cardiac affections which are symptomatic of a disordered digestive canal; yet, in the generality of those who are suffering from a primary affection of the heart, I have not only found the functions of the alimentary canal unimpaired, but in many cases the effect of a strong purgative is hurtful, especially when mercurials are combined with the purgative. In such cases the purgative irritates and increases the action of the heart, and brings on a number of most distressing nervous sensations.

These pernicious effects may be frequently observed, from the too indiscriminate practice of giving a dose of calomel at night, and a brisk purgative the following morning.

On the other hand, when purgatives are required, as in those cases of irritability of the heart caused by the retention of feculent matter in the large intestines, the evacuation of such feculent matter is essential, and is to be effected by those medicines which have a specific action on the large intestines, such as aloes, and castor or croton oil. A most decided evacuating effect will be produced by *croton* oil. The sixth, or even the twelfth part of a drop, combined with a few grains of colocynth, or with a teaspoonful of *castor oil*, is the dose I have usually employed; this may be repeated every few hours as may be necessary. The application of *croton* oil to the tongue, by its speedy action, affords a strong proof of the greater efficacy of medicinal substances when put upon the tongue, than when administered through other channels.

Case.

A young lady had been for some weeks much out of health; besides headache, restlessness, and mental irritability, the action of the heart was so greatly disturbed as to create anxiety about its condition; the bowels were very irregular; and she had no appetite ; to relieve all which she had used a variety of remedies. Observing the root of the tongue to be much furred, I gave her a pill containing the sixth part of a drop of *croton* oil with colocynth ; and, having taken two doses, she had several very copious fetid evacuations,—after which the disturbance of the heart, and all the other symptoms, were relieved.

"You ought to take care how you evacuate or fill up at once, or too quick, or too much ; and that it is equally dangerous to heat and cool again on a sudden ; or rather you ought not to do it, everything that runs to an excess being an enemy to nature."

Hippocrates.

CHAPTER XXXIII.

GENERAL OBSERVATIONS ON THE REMEDIES EMPLOYED FOR THE TREATMENT OF DISEASES OF THE HEART.

THE CHEMICO-VITAL PROCESSES OF THE LUNGS.

The incrementitious and excrementitious processes of the lungs; their influence on the sanguiferous system; how they differ from those processes of the digestive organs; nature of the pulmonary excretions; artificial coughing; purging the lungs; expectorants.

The incrementitious and the excrementitious processes of the lungs.

THE intimate relation which subsists between the heart and the lungs, and their reciprocal influence, both in health and in disease, lead us to inquire how the lungs are employed by the animal economy, to perform both an incrementitious and an excrementitious process. Indeed, these processes of the respiratory organs are as essential for the support of life, as those of the digestive organs. There is no system of the economy, which is more influenced by imperfections in the mode in which these processes of the lungs are performed, than the sanguineous. It may, therefore, be anticipated, that changes in the qualities and in the supply of the elements which are necessary to repair the blood, will produce such changes in the vital fluid as must, more or less, disturb the action of the heart.

How they differ from those of the digestive organs.

One striking difference, however, in the processes which are performed by the digestive and pulmonary organs is, that whilst the functions of the stomach are intermittent or periodical, those of the lungs are unceasing. "At every moment of his life, man is taking oxygen into his system by means of the organs of respiration: no pause is observable while life continues." Life can be long sustained without any supply of the elements of

Liebig.

nutrition derived from the food; but the supply of vital air to the lungs never can be interrupted.

Although man is enabled by his instincts to make choice of the aliments which are best suited to his digestive organs, the atmosphere, which is ordained for his breathing, always contains the same proportion of vital air, but it is often contaminated by pernicious matters; these passing into the blood, and causing many of those diseases which are attributed to *climate.*

Nature of the Pulmonary excretions.

By the excrementitious process of the lungs, none of the oxygen which has been received by them, remains in the system; but it is excreted during expiration, after having formed carbonic acid gas, and the vapour of water, by uniting with the carbon and the hydrogen, which had entered the system with the food. But in disease, not only these excretions, but other matters, which are inconsistent with health, are removed from the system by the lungs.

As the digestive organs yield products without these products having contributed to the nourishment of the body, in like manner, the lungs imbibe and convey to the blood, matters which are afterwards excreted; the retention of which in the body would be injurious; and if either of the proximate elements of food, or of the atmosphere, be taken separately, the health is injured, and death soon ensues.

"In organic life there is a double movement, the one is constantly adding to the animal, the other decomposing it. Its organization is always the same, but the elements are constantly varying. The molecules of nutrition, alternately absorbed and rejected, pass to the plant, and from the plant again to the animal. Organic life is subservient to this constant circulation of matter—one order of functions assimilating the elements of nutrition, the other separating those which have become heterogeneous. The process of assimilation is the result of digestion, circulation, respiration, and nutrition. Every extraneous molecule receives, before it becomes an element, the influence of these four functions. The sanguineous system is the centre of organic life, just as the brain is that of animal life, in which circulate the molecules which are to be assimilated; and also those which have served the purpose of assimilation."

Bichat.

Pneumonics.

The mucous membrane which lines the bronchi, like the external skin, performs an excrementitious function: this pulmonary excretion becomes variously modified in diseases of the heart, and copious mucous discharges take place—all of which processes are employed by the economy to mitigate disease.

"There is a constant and considerable exhalation of moisture from the cavity of the lungs—and there are many reasons for believing, that this is an *excrementitious* secretion, connected with the other excrementitious secretions, particularly with the perspiration from the surface of the body."

Cullen's *Mat. Med.*

Even before the time of Hippocrates, physicians talked of "purging" the lungs, using that term in the same sense as it has since been employed to signify the purging of the alimentary canal; and of such importance did they consider it requisite for the cure of diseases of the chest, that they artificially produced "*coughing* in order to evacuate the excrementitious secretions from the bronchi." To purge the lungs, the patient was ordered "to draw in his tongue as much as he was able, and when that was done, the physician endeavoured to put into the hollow of the lungs a liquor that irritated the part, which, raising a violent cough, forced the lungs to discharge the purulent matter which was contained in them."

Artificial coughing first introduced by the Cnidian physicians.

The lungs, how purged.

See Le Clerc's *History of Physic.*

It may be here observed, that the act of vomiting, besides evacuating the stomach, has, likewise, a mechanical effect upon the lungs, evacuating from the bronchi those accumulations of mucus for which coughing alone is not always sufficient. In cases, where there is also collected a large quantity of mucus in the stomach, vomiting is frequently accompanied with violent coughing; so that by the two acts—vomiting and coughing, a morbid collection of mucus, both in the stomach and in the lungs, may be freely evacuated.

There is indeed a strict analogy between the acts of vomiting, coughing, sneezing, weeping, and purging; each being accompanied by muscular movements employed by the economy to remove an excretion, either from the stomach, from the air-tubes; from the nasal or lachrymal passages; or from the alimentary canal.

Gases exhaled by the lungs.

But the lungs perform another, and a most important excrementitious function by the *gases* which they exhale; the quantity of the pulmonary exhalation being no less remarkable than what takes place from the cutaneous surface.

Colliquitive sweats.

This excrementitious function of the lungs may be also executed by the skin; the interchange of function between the lungs and the skin is exemplified in those diseases wherein a large portion of the lungs is disorganized and unable to exhale the requisite quantity of carbonic acid; in which cases the exhalation is performed by the skin. And when neither the lungs nor the skin can any longer execute this function sufficiently, then the lungs become filled with carbonic acid; from the deleterious effects of which upon the system, the vital powers sink, and thus life is gradually, and as it were insensibly extinguished!

Ansell's *Lectures on the Blood.*

Expectorants.

In those disturbances of the heart which are either caused or aggravated by that condition of the pulmonary mucous membrane, which is relieved by expectoration, there is no more useful expectorant than the *tartarized antimony.* When given in sufficient quantity to cause vomiting, such are its mechanical effects that it often has a powerful influence in evacuating whatever morbid mucus may have been collected in the bronchi; but when given in doses sufficiently small to be absorbed into the blood, it then has a decided influence on the pulmonary circulation; so that while the mucous secretion is facilitated, there is also produced a corresponding diminution in the inflammatory symptoms. The same specific effect is produced upon the pulmonary mucous membrane by the administration of the tartarized antimony, as is produced by that medicine on the mucous lining of the alimentary canal.

Besides antimonial preparations, there are other medicinal substances which act upon the pulmonary mucous membrane; such as *ipecacuanha* combined with *opium*, *squills*, the *balsams*, the *mineral acids*, *ammonia*, and *ether;* all of which may with propriety be employed to relieve different morbid conditions of the mucous membrane of the lungs accompanying disorders of the heart.

These substances may either be inhaled, taken into the stomach, or be absorbed by the skin, and thus conveyed by the blood to the respiratory organs.

The experiments of Orfila,

and of Brechet and Edwards.

Thus the pulmonary exhalation contracts the odour of many substances which have been taken into the stomach, or absorbed by the skin, such as ether, camphor, and garlic. The experiments of Orfila have shown that the molecules of substances, which have passed through the intestinal canal, also abound in the pulmonary exhalation; a ligature placed upon the œsophagus proving that such exhalation could not have come from the stomach. Turpentine injected into the crural vein was exhaled by the lungs.

CHAPTER XXXIV.

GENERAL OBSERVATIONS ON THE REMEDIES EMPLOYED FOR THE TREATMENT OF DISEASES OF THE HEART.

THE CHEMICO-VITAL PROCESSES OF THE CUTANEOUS SYSTEM.

Relation of the heart and cutaneous system; interchanges in the functions of the organs of excretion; different portions of the skin perform different functions; dermatics; sudorifics; cold and warm baths; anointing the skin; absorbents; refrigerants; pustulation; vesication; rubifacients.

Relation of the heart and the cutaneous system.

THE reciprocal influence of the cutaneous capillaries and the organs of circulation when in health, and also the state of the skin produced by changes in its capillary circulation, are the most useful tests that we possess of the condition of the heart, and point out an important channel for the employment of remedies: for whether the surface of the skin be hot or cold, dry or moist, these conditions all indicate particular states of the heart's functions.

At the same time, there are two other important channels by which the heart and the skin are related, — the cutaneous *absorbents* and *nerves;* through both of which, as well as through the *exhalents*, there is a class of medicines which act upon the heart.

The interchange in the functions of the organs of excretion,

The circumstance, that all the different functions of excretion not only co-operate with one another, but the interesting fact, formerly mentioned, that when any of these functions is deranged, the excrementitious process can be duly performed by one of the others, points out how it is, that, when either of them is interrupted, the economy employs another to supply its place.

is remarkable in the lungs.

This interchange, or reciprocity of functions, is forcibly illustrated in the skin; for whenever the lungs are diseased, or even when there is a temporary interruption in their exhalation, the perspiration is increased, the skin discharging that carbonic acid which the lungs are unable to exhale.

Pathological illustrations.

In those suffering from pulmonary *phthisis*, the exhalation of carbonic acid from the lungs being then diminished, there is a proportionable increase in the exhalation from the skin: hence we can explain the relief which they obtain from sweating. When there is more or less pulmonary congestion, accompanied with *bronchitis*, the relief of perspiration is also produced by the skin fulfilling the office of the lungs; thus performing that office which the lungs had not been able to accomplish.

How often does it happen, that by dancing or taking violent exercise on horseback, the sweating which ensues cures a catarrh! It may be truly said, that whenever any portion of the lungs cannot respire, the skin then respires for it.

We likewise find, that if the evacuations from the alimentary canal be interrupted, the skin contributes, with the other organs of excretion, to separate and discharge from the blood those excrementitious compounds which are usually evacuated from the bowels; and whenever the excretions of the liver or kidneys are interrupted, their functions are also assisted by the skin.

Difference in the functions of different portions of the cutaneous surface.

There is every reason to believe, from observations which have been made in examining the skin, that the quantity of perspiration varies in different parts of the cutaneous surface. In Cruickshank's experiments, the average quantity exhaled by the hands was in the ratio of double the quantity exhaled by the whole body. When we want to ascertain in a patient the condition of the skin, our attention is always first directed to the *palm* of the hand, as in it we perceive the most sensible deviations from the natural state. Sometimes it is hot, and sometimes cold; sometimes it is covered with a warm perspiration, and sometimes with a cold moisture.

That different portions of the skin perform different functions, accords with what is observed of other systems of the economy. Thus there are peculiarities in the structure of different parts of the skin, in order to serve different purposes; such as differences in the vascularity; in the quantity of nerves and absorbents; and in the epidermis; all which differences may likewise be observed in diseases, particular eruptions chiefly affecting particular portions of the cutaneous surface.

In affections of the heart arising from changes in the qualities of the blood, especially in those where its excrementitious materials have not been duly discharged from the system, more or less relief is obtained by augmenting perspiration. Of this we have an example in jaundice; in which disease sweating, as well as increasing the action of the other organs of excretion, is a valuable remedy.

Its effects in gout.

The effects of sweating in warding off *gout* are very remarkable; that excretion, discharging from the system those vitiated secretions of the digestive organs, which, when they are mixed with the blood, create a gouty paroxysm; and which by no means unfrequently attacks the heart, producing more or less arthritic inflammation of its internal membrane. In this manner, and upon this principle, there are many persons of an arthritic diathesis who, by daily taking sufficient exercise to cause a copious perspiration, are enabled to ward off an attack of gout.

Case communicated by Mr. Faxon.

A young man who had frequently suffered from gout, to which disease he had a hereditary disposition, was in the habit, whenever he was threatened with an attack, to clothe himself very warmly and walk briskly, so as to induce a copious perspiration, by which he warded off the paroxysm.

In the exhibition of "cardiacs," there is no sign more characteristic of their beneficial effects, than their influence on the cutaneous capillaries.

Case.

A lady, who had long been affected with a disordered heart, was completely relieved after a profuse perspiration.

In violent exercise.

The influence of sweating upon the circulation is well exemplified in the relief that it affords when it has been produced by violent exercise. On making any muscular exertion, the first effect of it, is to cause the lungs to be more or less congested, and, consequently, to diminish the exhalation of the usual quantity of carbonic acid. But, whenever a copious perspiration ensues, the excretion of carbonic acid, which it produces, relieves the lungs; and thence follow that immediate vigour in breathing and sense of exhilaration with which we are all so familiar.

The different sudorifics,

The means we possess to increase perspiration, or to produce sweating, appear to act primarily upon the heart, by which changes in the functions of the cutaneous capillaries take place.

The mechanical action of *vomiting*, and the influence of nausea upon the functions of the heart, have a powerful effect on the cutaneous capillaries, producing perspiration more or less profuse : thus constituting one of the most influential means which we possess for imitating that which the economy resorts to for causing perspiration for the cure of disease.

This salutary effect of sweating must contribute to sustain the health of those who are daily exposed to great toil. We learn, too, from a very early period of history, that, by sweating, the greatest benefit was derived by the "Athletæ," and those who were trained to make powerful muscular efforts. The beneficial effects of sweating are also remarkable in *horses :* it being well known that they cannot be got fit to make any powerful exertion without being regularly "sweated."

But sweating, like purging, is also a symptom of disease; and it may be as expedient to arrest such morbid perspiration by remedial means, as it would be to stop a diarrhœa.

Dermatics.

Utility of sweating.

There is no excrementitious process more frequently employed by the animal economy for the relief of disease, than *sweating*, and its curative effects are valuable in various affections of the heart.

"All diseases are determined or cured by evacuations by the mouth, by stool, by urine, or some other such way; but *sweating is common to all, it takes off all alike.*" Hippocrates.

Sudorifics, when to be employed.

The affections of the heart, in which artificial or augmented perspiration is particularly useful, are numerous.

Sweating is employed in those affections where the disorder of the heart has been occasioned by derangements of the capillary system; in all which the restoration of the cutaneous capillary circulation never fails to relieve the heart: in the heart's inflammatory affections it is equally beneficial to increase the excrementitious discharge of the skin.

In like manner, as vomiting is cured by an emetic, and a diarrhœa by a purgative, sweating may be sometimes cured by sudorifics.

Case.

A young lady was extremely debilitated, and had such profuse perspirations, especially at night, that her linen was changed frequently three times during the night. I gave her a dose of Dover's powder at bed-time, and the sweating did not return.

Of the medicinal substances usually employed to produce sweating, there is none more efficacious than the *tartarized antimony*, or *James's powder*, given in small doses, either singly or in combination with a purgative. *Opium*, combined with antimonial or mercurial preparations, the compound powder of ipecacuanha or the *Dover's powder*, the *acetate of ammonia*, and the *citrate of potass*, or of *soda*, are all useful sudorifics.

In administering those medicines, we have another example of that analogy, in the effects of medicinal substances, to the curative processes which are employed by the animal economy. In the same manner as one organ of excretion can perform the functions of another, so medicinal substances either act upon one or other of the excreting organs. Tartar emetic acts either on the skin, on the pulmonary mucous membrane, or on that of the alimentary canal, causing either sweating, expectoration, or purging; it is the same with calomel, that mercurial preparation either increasing the mucous secretion of the intestines, evacuating the gall-bladder, increasing the biliary and renal excretions, or producing perspiration.

Effects of temperature.

The same remedies which act upon the heart through the medium of the skin, exert their influence, not only upon the cutaneous nerves, but, as has been also pointed out, on the cutaneous *capillary system*.

Whatever may be the effects of warm and cold bathing, of the vapour and shower baths on the capillaries, there is doubtless a great impression made by the sudden application of cold or heat on the action of the heart, from the effects which they produce on the cutaneous nerves. Thus *heat* and *cold* applied upon the cutaneous surface become useful therapeutic agents in disorders of the circulation.

The changes which take place in the functions of the heart, from the application of cold and heat upon the skin, as also upon the gastro-pulmonary mucous surfaces, explain the curative effects which are derived from *cold and warm bathing*, from *refrigerants*, from *rubefacients*, and from *anointing* the cutaneous surface.

Effects of warm and cold drinks.

Warm and cold drinks, like warm and cold substances applied to the cutaneous surface, have each of them a powerful influence in causing perspiration.

Warm drinks are commonly resorted to either to restore the natural warmth of the skin, or to cause sweating; cold drinks are equally efficacious in producing both these effects upon the cutaneous capillaries.

Calefacients and Refrigerants.

I have pointed out the great influence which very cold substances, taken into the stomach, have upon the heart, and have made allusion to some instances where they proved fatal. It appears to me, therefore, that the changes produced in the action of the cutaneous capillaries, either by warm or cold drinks, arise from the effects which these have upon the action of the heart. In order to cause a copious perspiration, such as persons have recourse to who are in "training," it is usual after a long walk to lie down in a bed between blankets in a warm room, and to drink a quart of *cold* water, a short time after which a profuse perspiration ensues.

See page 156.

This beneficial effect of cold drinks accounts for the thirst and the strong desire which the sick have for them in febrile diseases, and in those stages of the disease where the skin is parched; and shows the propriety of allowing the sick to gratify this instinct of the economy.

Case.

An officer, in India, who was suffering from fever, overheard his medical attendants, when consulting together in an adjoining apartment, hold out no chance of his recovery. In this hopeless condition, he determined to gratify a great desire he had to drink *sangaree*, a beverage which is composed of vegetable acids and spirituous and fermented liquors greatly diluted; —after drinking a very large quantity of it, a profuse perspiration ensued, after which all the symptoms of the disease were immediately subdued, and he rapidly recovered.

The cutaneous surface is influenced by the local application of warm and cold substances, as well as it is by them when taken into the stomach.

Effects of warm and cold bathing.

The influence of the *warm bath*, in promoting perspiration, is universally acknowledged; the *pediluvium* and the *manuluvium* are also employed for the same purpose. There are some persons upon whom the warm bath has a very opposite effect on the capillary circulation, and, in place of being moist, the skin becomes hot and dry, accompanied with headache and quickened circulation; in such cases there will often be found a disorder of the heart. In like manner, there are some persons, in whom the *pediluvium*, in place of restoring the balance of the circulation, produces an injurious effect; in these instances there has generally been a permanent disorder of the heart.

Cases.

A lady suffered great distress in breathing whenever she put her feet into warm water. A maid-servant became faint on several occasions when she made use of the *pediluvium*.

The *pediluvium* and the *manuluvium* may consist either of water of a blood heat, or may be used as hot as the patient can endure it for a very limited time. In the first case, the feet and legs should be immersed from a quarter to half-an-hour, taking care to add warm water in sufficient quantity, that the bath may sustain the proper temperature during the whole time of the feet's immersion.

Besides the effects of the heat and moisture, stimulants may be added to the water, such as mustard, vinegar, or common salt, to increase the influence of the bath; or, if friction be desirable, the limbs may at the same time be rubbed with oatmeal or bran.

The application of *cold* to the cutaneous surface produces also a powerful influence on the capillary circulation; hence the use of the *cold* bath, the *shower* bath, the cold *effusion*, and *evaporating* lotions; all which require discrimination in their use, and particular attention to the condition of the heart; as there are many instances of evil effects having arisen from employing them, when the heart has been diseased.

The shower-bath, and sponging the surface of the body with cold water, produce beneficial effects on the heart. In those cases, especially, where there is a want of vigour in the general circulation, and when there is diminution in the proportion of arterial blood in the cutaneous capillaries, sponging the arm and chest, with diluted vinegar or salt and water, invigorates the heart's functions.

When alluding to the effects of cold in disturbing the action of the heart, cases were mentioned where eating ice and drinking cold water greatly disturbed the heart, and also where death followed the introduction of iced water into the rectum.

Case.

The greatest caution is necessary in the use of the cold bath. A case is narrated by Portal, where a lady, who had a disease of the heart, expired suddenly from going into a cold bath. "She had been a long time subject to palpitation, and accustomed to use the warm bath, but was advised to use it cold, with the addition of ice, and also to put on her head a bladder of pounded ice, when she fell into a state of syncope, and expired. The pericardium was found distended with blood; there was a rupture of the left ventricle, eight lines in length; the aortic orifice was contracted, and the valves ossified."

Anatomie Médicale, Paris, 1805.

Anointing the skin.

Unctuous applications to the skin is another therapeutic agent, employed either to prevent the imbibition of substances through the *epidermis*, or to be the channel of conveying medicinal substances to the cutaneous nerves and absorbents. They certainly prevent the epidermis from imbibing noxious matters, as we observe by the effects of anointing the hands before dissecting a dead body: not only is the skin guarded against contamination from the odour, but there is no absorption of any of the decomposed animal matter. This effect of oiling the skin is also exemplified by the comparatively small proportion of butchers, and of those who are employed in making use of oily substances, affected by cholera and contagious diseases.

The cutaneous surface, with its nerves, its capillaries, and its absorbents, is protected from the immediate contact of solid substances, and from the atmosphere, by the *epidermis*, and also by the secretion of the *sebaceous glands*. In diseases, when these natural coverings do not afford sufficient protection to the integument, benefit is derived from covering the skin, or that portion of it adjacent to the diseased organ, with oiled silk, or with a plaster, which may act, both by its non-conducting powers of heat, and also by the medicinal substances with which it may be compounded. The good effects of plasters are daily exemplified in relieving uneasy sensations, and sometimes even pain in the region of the heart.

Absorbents.—Having reviewed those medicinal substances which assist the process of digestion, and to which the absorbents of the digestive organs lend an essential aid, the remedial means which act upon the cutaneous and pulmonary absorbents next claim consideration.

Absorbents, it may be noticed, is a term which has two distinct significations. The substances which act chemically, such as chalk, upon fluids in the alimentary canal, or upon the puriform discharge of an ulcerated surface, have been denominated "absorbents" in works on the Materia Medica; whilst the medicines which increase or diminish the action of the lymphatic system, have also been called absorbents; in this signification is the term here employed.

The absorbent vessels perform an essential function in the animal economy, conveying to the blood the *incrementitious* products prepared in the digestive canal, and also those substances which are imbibed by the lungs and by the skin; hence any irregularity in the supply of these incretions must more or less change the qualities of the blood, and therefore the manner in which the absorbent vessels perform their functions must modify the action of the heart.

Whenever it is desirable to increase the action of the absorbents—and this is frequently the case when, during or after inflammatory affections of the heart, there has been some sero-albuminous effusion within the pericardium, or on the surface of the endocardium—there are medicinal substances by which the absorption of the morbid effusion can be increased. Of these the most powerful are *mercury* and *iodine;* the curative effects of these medicines are the same, whether they be taken into the stomach, applied to the skin, or inhaled by the lungs.

The cutaneous absorbents are frequently employed to imbibe medicines, which cannot be safely taken into the alimentary canal. When administering a course of mercury, if the bowels are irritated by its internal use, its influence on the digestive organs is guarded against, by causing the mercury to be absorbed by the skin.

Pustulation, Vesication, and Rubefacients.

The formation of eruptions and pustules.

Besides sweating, the skin performs excrementitious processes by the formation of *eruptions* and *pustules* : these discharge from the blood serous and puriform fluids, and, like the other excretions, which we have been considering, they are also employed by the *vis medicatrix* for the cure of disease.

Their curative effects.

The importance of these excrementitious processes, we can measure only by the effects which are produced upon the system, when they have been interrupted by external agents, such as by changes in the temperature of the atmosphere, or by the application of substances which arrest their progress. In no organs are the injurious effects of an interruption to these excrementitious processes more remarkable than in the organs of circulation ; for, if the noxious matters which these processes are destined to expel from the body be not removed by the appropriate organs, the blood becomes vitiated, and the action of the heart more or less disordered.

Injurious effects of checking them.

In the *exanthematous* diseases, the hurtful effects of checking, by any artificial means, the progress of the eruption, or of altogether preventing its appearance, are well known, and always lead to an increase in the action of the heart, and to all the febrile symptoms, which can only be allayed by restoring the eruption, or by increasing some of the other excrementitious processes.

In chronic eruptions, the effects of arresting their excretions by any external applications is still more pernicious. It is by no means uncommon to meet with instances, where persons with an eruptive disease of long standing, and limited even to a very small portion of the cutaneous surface ; and who, from making use of some application by which the eruption had been checked, have suffered from various ailments arising from disturbances of the circulation—all which are quickly removed whenever the eruption re-appears, or when depletive means are judiciously adopted.

How they can be imitated.

In imitation of these processes of the economy, we can produce *pustulation* and *vesication ;* the formation of artificial pustules separating from the blood a puriform fluid, and vesication separating from it a serous exudation.

In the disorders of the heart which are connected with changes in the qualities of the blood, especially those accompanying "exanthematous" diseases, and inflammatory diseases of an "arthritic or rheumatic" character, pustulation and vesication, and rubefacients, which may be considered as a milder degree of vesication, are valuable remedies. These remedies have the advantage of acting quickly, and are applicable to the more acute forms of disease, whilst pustulation, as well as setons and issues, is generally made use of in chronic affections.

The skin is a useful channel for conveying medicinal substances into the blood. Thus it is when administering a course of mercury, if the bowels are irritated by its internal use, its influence on the alimentary canal is guarded against, by causing it to be absorbed by the skin.

CHAPTER XXXV.

GENERAL OBSERVATIONS ON THE REMEDIES EMPLOYED FOR THE TREATMENT OF DISEASES OF THE HEART.

THE CHEMICO-VITAL PROCESSES OF THE GENITO-URINARY SYSTEM.

The kidneys only excrete; their consent with the heart; influence of the passions on the kidneys; interchange of their functions; diuretics; genetics.

The kidneys excrete urine only.

It has already been remarked, that the *kidneys* are unlike any of the other excrementitious organs, except the uterus, as they perform no other function but excretion; nor does their function seem to be so intimately associated with those of the sanguineous system, as are those of the other excrementitious organs; yet the effects of general excitement, and of the hysteric paroxysm, in causing a more or less sudden increase in the flow of urine, sufficiently point out their relation with the heart, and their reciprocal connexion both in health and in disease.

Their consent with the heart.

Influence of the passions on the urinary excretion.

The influence of the passions on the circulation seems to produce effects upon the kidneys precisely analogous to those which we so frequently observe on the skin by causing sudden perspiration; and also upon the mucous membrane of the alimentary canal by causing diarrhœa,—effects which, in disturbances of the heart, must, however inexplicable, fulfil some essential purpose in the animal economy.

Interchange in the function of the kidneys.

The same interchange takes place between the kidneys and the other organs of excretion as between the skin, the lungs, and the alimentary canal, each in its turn performing the functions of the kidneys.

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Diuretics.

Nephritics.

In like manner, as we possess the means of increasing the quantity and of altering the qualities of the excretions from the skin, and from the alimentary canal, so we have medicinal substances which increase the quantity and change the qualities of the urine.

Their modes of action.

Some *diuretics* are absorbed, and pass unchanged with the blood into the kidneys, such as potass, turpentine, and cantharides, whilst there are others which undergo chemical changes before they reach the kidneys, such as the acetate and supertartrate of potass. And, as has been remarked of the other organs of excretion, on which alone some medicines act, so as regards the kidneys, diuretics produce their particular effects, through whatever channel they may have been introduced into the system—whether they be received into the stomach or inhaled by the lungs. A few minutes after a solution of prussiate of potass was injected into the lungs, that salt was found present in the urine.

Barbier, *Mat. Med.*

The quantity of the urine may be changed by them,

There are some medicines which change the *quantity*, and others the *qualities*, of the urine.

Water and diluent drinks increase the urinary secretion, by passing rapidly to the kidneys; the exposure of the skin to a cold temperature, by diminishing the cutaneous exhalation, also causes an increase of urine.

There are medicinal substances which, by promoting the absorption of the fluids effused into the serous cavities, convey them to the blood, whence they are excreted by the kidneys. *Mercury*, *digitalis*, and *squills*, have this effect in a remarkable degree; these medicines are of great value, either when used singly, or combined with one another.

In those disorders of the heart, where any of the excretions are imperfectly performed, diuretics are a useful remedy, and their exhibition is pointed out especially in those maladies where there is any effusion within the pericardium; which effusion we know, is not only relieved, but frequently warded off by the judicious use of diuretics. Hence the employment of this class of medicines in diseases of the chest has been deemed very important, since an early period of medical history.

The *qualities* of the urine are variously altered by derangements in the digestive process, which often cause disturbances in the circulation, so that by improving the digestive function, we can change the nature of the urine, and thus relieve the disorder of the heart. *Alkalis*, *iodine*, and the mineral *acids*, are especially useful in the treatment of the diseases of the heart of an arthritic, and of a rheumatic character; in both which the digestive function is usually more or less deranged.

and likewise the qualities of the urine.

Genetics.

Menstruation.

The periodical sanguineous exhalation, which takes place from the uterus, is another excrementitious process; and any irregularity in the accession of the period, or any change in the quality or in the quantity of the discharge, is a frequent cause of a disturbed heart. There is indeed no excretion, the healthy condition of which has a greater influence on the heart than the menstrual flux; for we invariably find that every derangement of that function is either preceded by, or causes, more or less disturbance of the circulation: this relation between the heart and the uterus will satisfactorily explain the curative effects of *emmenagogues* in those diseases of the heart which are accompanied by a disordered uterus.

Its influence on the functions of the heart.

Such, too, is the intimate relation between the uterine and the circulating organs, that the various interruptions and changes to which the menstrual flux is liable, exercise a powerful influence on the sanguineous system. In the treatment of diseases of the heart accompanied with uterine derangement, it is, therefore, of essential importance to employ either, such means as will restore the balance of the circulation when the menstrual excretion has been interrupted, or, will improve the qualities of that excretion when they have been changed. Hence the use of *emmenagogues* in many of the disorders of the heart, a class of medicinal bodies, some of which appear to act directly upon the uterine system, and others through the medium of some of the other systems of the economy.

Peculiar character of the uterine excretion.

The menstrual flux, it ought to be remarked, materially differs in many respects from all other excretions. It commences only at a particular time of life, it occurs periodically, and at a certain age it ceases altogether. It consists, not of the separation of any excrementitious matter, properly so called, but of a sanguineous exhalation from the mucous membrane of the uterus, by which process a superabundant quantity of the vital fluid is abstracted from the body; the system being provided with an extra quantity of blood only during that part of woman's life when impregnation may take place, and when such extra quantity of the vital fluid may be required for the nourishment and growth of the fœtus.[1]

Menstruation co-operates with other excretions.

This excretion appears also to co-operate with the lungs and the skin in removing *carbon* from the system. The respiratory and uterine systems are so intimately associated, that, during the menstrual flux, it has been ascertained that much less carbon is exhaled by the lungs; and that after the cessation of the menses, there is a considerable increase of carbon in the pulmonary exhalation. Accordingly, there is a remarkable change in the odour of the breath in a woman during menstruation, arising probably from the uterus during that period assisting the lungs in discharging carbonic acid.

Like the other excretions, menstruation may also be performed by other organs when the uterus is incapable of executing it. It may be performed by the different portions of the gastro-pulmonary mucous membrane, and also by ulcers, and by diseased growths.

Use of Emmenagogues.

The condition of the heart varies exceedingly, according to whether there is a complete interruption to the flux, whether it be irregular, whether its quantity be increased or diminished, or whether there be a change in the qualities of the exhaled fluid.

Our curative means enable us, not only to restore the menstrual excretion, but also to relieve the system from the evil effects of its suppression. When the menstrual flux is completely interrupted, as often happens from the feet having been exposed to cold, or from any violent mental emotion, we can imitate the flux, and relieve the system, by artificially abstracting the blood which should have been evacuated by the flux. In this, as in a plethoric state of other organs, *bloodletting* and other depletive measures are indicated; for the abstraction of blood will at all times mitigate the symptoms arising from any congestion in the heart, and improve the general health.

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[1] Brande found that the menstrual flux resembles in its component parts a very concentrated solution of colouring matter in a diluted serum.

But, to insure the return of the flux, the active means should be employed immediately before the usual period of its accession; the best calculated to effect this purpose, besides bloodletting, are those remedies which act upon the uterine system. *Emmenagogues—emetics*, *purgatives*, and the *pediluvium*—powerfully assist in restoring a suppressed menstruation; above all, there is no emmenagogue more to be relied upon than an *emetic.*

In disturbances of the heart, accompanied with changes in the *qualities* of the blood, and by irregularities in the uterine excretion, the condition both of the uterus and heart can only be relieved by the use of those medicines which change and improve the qualities of the blood, such as the various preparations of *iron*, of *zinc*, and of *copper*.

CHAPTER XXXVI.

GENERAL OBSERVATIONS ON THE REMEDIES EMPLOYED FOR THE TREATMENT OF DISEASES OF THE HEART.

INFLUENCE OF THE CHEMICO-VITAL PROCESSES ON THE BLOOD.

The blood replenished by the food and air; its power of coagulation may be increased or diminished; its qualities changed by mental excitement; fatal influence of it; hæmatics, antimony, mercury, acetate of lead, sulphate of iron, copper and zinc, nitrate of silver, potass, soda, iodine.

The blood is replenished from the digestive and from the respiratory organs; and the vital fluid is composed of ingredients, some of which are incrementitious, and others are excrementitious.

"The blood contains the elements of all the tissues. Its fibrine is the same as the muscular fibre; its albumen, that which forms membranes; its fatty matter, combined with albumen, the nervous mass; and its phosphates of lime and magnesia, constitute the bones." Bichat.

Effects of air in the blood: Hunter.

All the elements received into the blood by the processes of digestion and respiration, are not always required for nutrition, but occasionally the incretions are of a hurtful nature; and, after being separated from the blood, they are discharged from the body. It happens, also, that when these hurtful matters are not duly excreted, the vital fluid remains permanently contaminated.

As changes in the incretions alter chiefly the arterial blood, and changes in the excretions alter the venous blood, yet, whenever the excretions are imperfectly performed, the arterial blood remains vitiated, in consequence of its excrementitious constituents not being discharged from the body.

The coagulation of the blood,

A diminished power of coagulation in the blood is a remarkable condition of the vital fluid which is sometimes met with; from want of this power very slight wounds have terminated fatally.

No less remarkable is that property of the blood by which it coagulates sooner than in ordinary circumstances, a quality which it has, not only in some diseases, as in plethora, and in inflammatory affections, but which it acquires from large and repeated hæmorrhages. This power of coagulation, which is evidently intended for the wisest purposes in the animal economy, warding off the fatal effects of a hæmorrhage from a disease or from an injury, has been ascertained, by experiments on animals, to increase in proportion to the degree of debility, caused by repeated blood-lettings.

its curative effects.

Babington.

Indeed, it may be satisfactorily explained how the frequent bleedings, one of the principal means employed by Valsalva for the cure of aneurism, must produce their curative effects, by enabling the blood more easily to coagulate in the aneurismal sac.

A remarkable change in the blood is caused by mental excitement, of which there have been many instances in *nurses*, in whom, when suckling the child after some violent emotion, the qualities of the milk has been so much changed that it has poisoned the infant, and convulsions, or even death, have ensued.

These qualities of the blood enable us to explain the rationale of some therapeutic agents, as well as some pathological phenomena, in diseases of the sanguineous system.

Hœmatics.

Besides those disturbances in the functions of the heart which are caused by changes in its supply of blood, there are other and very numerous disorders, which are caused by changes in the *qualities* of the blood. As the blood is the natural stimulus of the heart, every change in its qualities necessarily deranging the functions of the heart, *hœmatics* may, therefore, be justly considered a very important class of remedies in the treatment of disorders of the circulation.

During the progress of disease we constantly observe the sick changing their food and drink, being impelled by instinct to make choice of what is best fitted to relieve the symptoms of their ailment. Hence it is, that he, who is suffering from a febrile disease, rejects animal food, and freely partakes of diluent drinks; the stomach, during fever, being quite incapable of digesting solid aliments; whereas diluent drinks are easily absorbed, and cause a copious perspiration, by which the febrile symptoms are mitigated. Some of the sick desire to live on vegetable food, or fruits, whilst others can best digest animal food; some choose salted, and others fresh meat; some select acidulated drinks. The gratification of these peculiarities in taste is generally found, not only to be the most palatable, but the most easy of digestion, and therefore the most appropriate.

It is thus that the animal economy is endowed with means by which the healthy condition of the blood may be restored; and there are also medicinal substances, which, when conveyed to the blood, have specific effects in changing its qualities.

Barbier, *Mat. Med.* Paris, 1820.

Experiments have shown that the molecules of medicinal bodies absorbed and mixed with the blood, are found in that fluid throughout the body; yet these molecules act only on particular organs, affording a striking proof of one of the general laws which I have already pointed out. Madder reddens the bones, whereas milk soon partakes of any aliment which the mother may have taken; there are other matters which, being unfit to be retained in the blood, pass directly to the organs of excretion, and are by them discharged from the system. Thus we can, from these phenomena, explain how the urine is so easily affected by certain medicines; for the kidney is the organ by which the system expels noxious substances that are mixed with the blood, or that are not susceptible of assimilation.

Of the precise nature of the changes which take place in the arterial blood of different organs, we are perfectly ignorant; and we are, also, but little acquainted with the difference in the venous blood which is returned from each organ; for as every organ secretes from the blood a different product, so it must happen that the venous blood from each of them must be different—differences which chemical science has not yet explained.

To remedy disorders of the heart depending upon a morbid condition of the *blood*, we possess a variety of medicinal bodies; by some of which the qualities of the whole mass of the vital fluid can be changed, whilst others remain in the blood unchanged, and are conveyed by it to particular organs. The medicines that enter the blood unchanged produce their influence on the sanguineous system, either by their direct contact with the surface of the vessels, such as the preparations of antimony, iron, copper, silver, lead, and the alkalies; or they make an impression upon the nervous system, as opium, digitalis, and other neurotics.

Utility of antimonials,

When inquiring into the remedial effects of nausea and vomiting, I remarked that there was no medicinal substance which had a more powerful influence upon the heart than the preparations of *antimony*. The virulent disputes which medical history records, in reference to the effects of this medicine, exhibit such a discrepancy of opinion, and even such a distortion of facts, that it is impossible to avoid impugning the veracity of some of the disputants. Antimony, at least the *tartarized antimony*, is now, however, universally admitted to occupy a prominent place in the Materia Medica; and it is justly considered as one of the most important medicines employed in the treatment of diseases of the circulation.

That the *tartarized antimony* acts powerfully upon the heart there is most incontrovertible evidence afforded by the phenomena which follow its exhibition; and particularly if we observe its influence upon the functions of the heart when these are deranged. Whether these effects be caused by its coming into contact with the heart's surface, when mixed with the blood, or whether it be the cerebro-spinal system which is first influenced, and subsequently the cardiac and pneumo-gastric nerves, it is sufficient for our present inquiry to point out the curative effects which are produced by its exhibition in the diseases of the circulation.

Besides the influence of the *tartarized antimony* in creating nausea and vomiting, there are other effects produced by it on the sanguineous system: whatever may be the explanation that is given of its mode of action, there is no doubt of the decided benefit derived from its administration in disorders of the heart; more especially in those functional disturbances caused by congestion, as well as in those affections of an inflammatory character.

in functional diseases of the heart;

in inflammatory affections.

I may remark generally, that in those functional ailments of the heart, where it has been expedient to abstract blood, the subsequent administration of the tartarized antimony is almost always useful. In affections also of an inflammatory type, and in those wherein depletion has been already employed, the effects of this medicine are decidedly beneficial. In both cases, the sensible influence of the antimony is to diminish the heart's impulse, and the frequency and vigour of the arterial pulse: these effects may be produced to any degree by regulating the dose of the medicine.

Rasori.

So powerful are the effects of antimony on the circulation, that it has been often employed in place of bloodletting; so that whether the vigour of the circulation be reduced by abstracting a portion of the vital element, or by the influence of this medicine on the circulatory apparatus, its effect in febrile diseases, and upon an inflamed organ, appears to be in many respects analogous.

How to be administered.

In the use of the *tartarized antimony*, the same discrimination is required in conducting its administration, as in that of other active remedies. Different cases require not so much differences in the quantity of a dose as in the frequency of repeating the doses. In some it is sufficient to tranquillize the heart, whereas in others nausea, and even vomiting, are desirable; but in all cases its use need not be persevered in longer, than the symptoms, for which it has been administered, continue; for it is extraordinary how great a depression it sometimes causes when given beyond a certain time, or after the inflammatory symptoms have been subdued.

Steuart, *Lancet*, 1832.

Antimony long continued has been observed to cause wakefulness.

Salivation caused by its use.

That the long-continued use of antimony sometimes causes *salivation*, I have met with repeated proofs; and therefore its effects on the mucous membrane of the mouth, as well as on the salivary glands, should not be disregarded.[1] When the sickness caused by the use of antimony is excessive, it may be alleviated by giving a few drops of the hydrocyanic acid, should it be desirable to continue its use.

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[1] James met with six cases where salivation took place from the use of his "fever powder."

There are two preparations of antimony—the *tartarized* and the celebrated fever powder of *James*, both of which are applicable to the treatment of diseases of the heart; and from these all the curative effects of antimony may be derived.

The tartarized antimony may be given either in solution or in pills, or the salt may be put upon the tongue. When the digestive organs are not in a deranged condition, a pill composed of $\frac{1}{4}$ or $\frac{1}{3}$ of a grain of the tartarized antimony, combined with a grain of extract of rhubarb and of soap, will seldom cause sickness, especially if the stomach be not quite empty; and therefore I always recommend a single mouthful of solid food, as bread or biscuit, to be taken immediately before swallowing the pill, by which means nausea is very generally prevented. To avoid the influence which the mind might have in causing sickness, it is prudent not to allude to or prepare the patient for the possibility of such an occurrence.

It not unfrequently happens, however, that the first doses of the antimony which are taken cause nausea and vomiting; whereas subsequently they may be long continued without producing any perceptible effect upon the stomach. On the other hand, it does not unfrequently happen, that the first doses of this medicine have no effect on the digestive organs, but cause nausea and vomiting, after having been taken for a considerable length of time—antimony being one of those medicinal substances whose effects are sometimes *cumulative.*

When the tartarized antimony is to be given in solution, this is usually done by combining it with some neutral salt—such as the tartrate of soda, the sulphate of magnesia, or the supertartrate of potass—the effect of these seems to be to cause the antimony to act also upon the intestinal canal.

Antimony, combined with other medicines, will also be found a useful remedy in many affections of the heart. Its combinations with *gummy* and *saponaceous* substances has long been extolled: on this principle are compounded the celebrated pills both of Schmuker and of Richter.

With *mercury* it forms a very active compound, and generally in the inflammatory affections of the heart one grain of calomel with two or three of James's powder, given every six, eight, or twelve hours, according to the severity of the symptoms, has a most powerful effect in tranquillizing the circulation, as well as in acting on the digestive and cutaneous systems.

A similar dose taken occasionally is sometimes very effectual in relieving *chronic* affections of the heart. I say occasionally, because there are many individuals, whose biliary organs are at the same time deranged, and who may be much benefited by one or more doses of this compound, but who suffer exceedingly from its too frequent repetition; the mercury in such instances rendering the heart irritable, and increasing the number of its pulsations—a state, I may here mention, which, when it does take place, is relieved by camphor and ammonia.

Antimony, too, especially in the form of "James's powder," may be combined with *digitalis*, and with *colchicum*, each of which is an important remedy in some affections of the heart.

James's powder is a form in which antimony has been much used, and though its mode of preparation has never been discovered, its utility is universally admitted. In the treatment of disorders of the heart, I consider it to be oftentimes a milder and more easily manageable preparation of antimony than the tartarized, and less apt to create nausea and disturbance of the stomach. When taken singly it not unfrequently creates headache with heat of skin; but when given combined with a grain of aloes or rhubarb, these effects are generally prevented. In this manner four or five grains of James's powder may be given in chronic disorders of the heart, and continued daily for a very considerable time with the best effects.

Influence of antimony on mucous membranes.

The curative effects of the *tartarized antimony* in the diseases of the heart are derived from other channels, besides its influence on the organs of circulation. Its action is equally powerful on the gastro-pulmonary mucous membrane, and as many diseases of the heart are accompanied with affections either of the pulmonary, of the gastric, or of both portions of that membrane, the tartarized antimony will be found a most active therapeutic agent. In such cases great benefit arises from giving the medicine in doses sufficient to create nausea, or even vomiting; the act of vomiting removing not only any inordinate quantity of mucus collected in the stomach, but also evacuating mucus from the bronchi.

As an *expectorant* the tartarized antimony has long been extolled, and its specific influence upon the gastro-pulmonary mucous membrane amply confirmed by experience. Injected into the veins, it causes inflammation of the whole lining of the intestinal canal, especially of the mucous membrane of the stomach, duodenum, and rectum. In a case where a tablespoonful of tartarized antimony was swallowed by mistake, besides other effects, "the whole body was covered, three days after the medicine had been taken, with genuine tartar-emetic *pustules.*"

Case recorded by Dr. Gleaves.

I have already remarked, how requisite it is, when exhibiting the tartar-emetic, carefully to watch its effects, as they often produce great depression of the vital powers, and sometimes prevent sleep: medical records afford examples of persons who have sunk under the influence of nauseating doses of that medicine. When given in too large a dose, the violence of the action of the antimony may be arrested by a decoction of cinchona, or by any substance which contains *gallic acid*,—provided that the antimonial salt has not left the stomach.

Hurtful effects of antimony.

Barbier, *Mat. Med.*

With regard to the effects of *mercury* in the treatment of the diseases of the heart, I have already noticed, that it is employed in its inflammatory affections, as advantageously, as it is in the same class of maladies in other organs; and likewise in those ailments of a chronic character, wherein the hepatic system is also deranged. I have likewise alluded to the peculiar, and sometimes even poisonous effects which it produces on the heart when mixed with the blood—a circumstance that well merits attention in the administration of mercurial medicines.

Effects of mercury on the blood.

The preparations of *lead*, of *iron*, of *copper*, of *zinc*, of *silver*, and of *alum*, are all remedies, which have, by the changes which they produce on the qualities of the blood, a specific effect on the action of the heart, and I have grouped them together, as their effects are very analogous; whereas antimony and mercury have an influence on the circulation of a very different character.

Preparations of either of these minerals may be most beneficially employed in disorders of the circulation; that of *lead* is

Effects of lead.

perhaps the most remarkable. Of this we have a striking example in the exhibition of the *acetate of lead* in pulmonary hæmorrhage symptomatic of cardiac congestion; for arresting which there is no more powerful remedy, especially when combined with *opium*. Besides, I am convinced, that the good effects of lead are not merely to stem the bleeding, but that, like the preparations of iron, zinc, and copper, all which change the qualities of the blood, the acetate of lead may be continued with great advantage in such cases for a lengthened period, and after all tendency to hæmoptysis has ceased.

Effects of iron.

Of the metallic salts, those of *iron* are chiefly in use for the treatment of those conditions of the circulation arising from changes in the blood's qualities; and there is none of its preparations more to be depended upon than the *sulphate* of iron. From half a grain to a grain of this metallic salt, combined with the extract of gentian, or with the compound galbanum, or myrrh pill, may be taken two or three times a day; when it is necessary to regulate the bowels, half a grain of the powder of aloes may be added to the pill.

Effects of copper and of zinc;

What has been said of the use of iron is applicable to the preparations of *copper* and of *zinc;* the *sulphates* of both these metals having effects on the heart very analogous to those of iron, and are usually given in the same doses.

and of silver.

As regards the *nitrate of silver*, the diseases in which it has been beneficially employed, are of various characters; and though no rational explanations of its effects have been given, yet I am persuaded that it relieves disorders of the circulation by changing the *qualities* of the *blood*.

The erroneous notion of increasing the *quantity* of a medicine, according to the urgency of the symptoms of the disease, is fully verified in the use of these different metallic salts; for it will be found, that when given in large doses, they have either less influence than when taken in smaller doses, or they are absolutely not absorbed at all, but pass through the alimentary canal unchanged.

Effects of alkalies.

There is no class of medicinal substances which have longer preserved a high reputation for their curative effects upon the blood than the *alkalies*. In those disorders of the heart where the qualities of the blood are changed, especially in rheumatism, gout, and in scrofula, the alkalies are most useful remedies. The carbonates of *potass* and *soda* combined with *cinchona*, or with rhubarb, and, above all, the combination of potass with iodine,—the *hydriodate of potass* is a most efficacious remedy; especially in those cases where the heart has suffered any inflammatory disease, and where there is reason to suspect that some sero-albuminous effusion, on the serous membranes of the heart, has not been absorbed.

CHAPTER XXXVII.

GENERAL OBSERVATIONS ON THE REMEDIES EMPLOYED FOR THE TREATMENT OF THE DISEASES OF THE HEART.

THE VITAL PROCESSES.

Differences in the vital processes from the mechanico-vital, and the chemico-vital; they are executed by the vital powers, through the medium of the nervous system; neurotics; opium; digitalis; belladonna; tobacco; hyoscyamus; hellebore; aconite; colchicum; camphor; ammonia; chloroform; ether; alcohol; strychnine; hydrocyanic acid; embrocations; friction; percussion; titillation; acupuncturation; electricity; derivatives. Recapitulation.

Influence of vitality.

The vital processes are essentially different from those processes which are mechanical; nor do they resemble those which take place in the chemico-vital laboratory. In the vital processes no decomposition, nor new combinations of the constituents of the body are formed; but the vital principle—the *vis vitæ*—exerts its influence over, and controls every organ; executing those inexplicable phenomena, by which the line of separation is established between the living and the dead—between the organic and the inorganic world. No sooner does life cease than the animal frame undergoes a succession of chemical changes; the various organs are decomposed, and new compounds are formed, none of which have any resemblance to the elements which compose a living being.

Life and death.

"The varied and endless combinations in the works of Nature," a learned physiologist has justly observed, "all of them obviously regulated by design, imply wisdom and power, as much superior to those which are indicated in the works of art, as the unbounded knowledge of Deity surpasses the limited intelligence of man. The mode in which many of these combinations are formed, must, from their minuteness, for ever elude the most penetrating eye; and from their intricacy, or from unknown causes, for ever bid defiance to human research."

The Muscular Motions of the Human Body, by John Barflay.

The vital principle acts through the nerves.

The cerebro-spinal system is the physical apparatus which is employed by the vital principle, to execute these wonderful phenomena; for which purpose, every point in the body has its corresponding point in the cerebro-spinal system.

These vital processes are executed, or they are each under the control of different portions of the cerebro-spinal system; the organs of organic life being governed by those of the ganglionic system; and those of animal life by nerves emanating from the spinal cord, as well as from the brain itself. Further, the influence of different "neurotics," and of different doses of them, upon different portions of the nervous system, affords a remarkable illustration of that law of the economy which I have already pointed out; and still more forcibly is that law illustrated by the difference in the effects of the elementary portions of these medicinal substances when separately administered. Thus the *oil* of *tobacco* acts upon the brain, and the *infusion* of *tobacco*, which contains *nicotine*, stops the action of the heart. *Opium*, in its crude form, acts as a stimulus over the whole nervous system, or as a sedative; but *morphine* acts only as a soporific, and *narcotine* causes the noxious effects which are usually attributed to opium. The same remark applies to what was formerly said of tea and coffee, when these were made use of before or after being deprived of certain of their principles.

Increase and diminution of the vital force.

Contemplating these vital phenomena, we find, that in some of them there is a diminution, and in others an increase, of the vital force;—a variety of causes producing these differences; some manifesting themselves when the body is in health; and others in diseases.

A *diminution* of the vital power is exemplified during sleep; the whole nervous system then being in a state of inaction, except that portion of it which supplies the organs of organic life. A like condition of the nervous system often appears in diseases with which we are familiar, as in palsy and catalepsy.

An *increase* in the vital power is manifested during the waking state as well as in diseases, of which we have examples in all inflammatory affections.

These variations in the diminution and in the increase of the vital power, must depend on the physical condition of the nervous system; as we have observed, that either the whole of that system, or that only a portion of it, is affected.

During sleep, and in some diseases, this change in the vital power is caused by a diminution in the vigour of the circulation, and by an increase in the proportion of the venous blood in the cerebro-spinal system; whilst in other diseases there is not only an increase in the proportion of the arterial blood in the nervous system, but there is also a change in its structure.

Influence of the sanguineous on the nervous system;

Thus it appears, that as the state of the nervous system depends on the state of the sanguineous system, every change in the vigour of the circulation, or in the qualities of the blood, must modify the operations of the nervous system; in the same manner, as the sanguineous system cannot duly execute its functions without the influence of the nervous system, so the nervous system cannot perform its functions without a due supply of blood. The brain is as dependent on the heart, as the heart is on the brain.

and of medicines.

The vital processes, whether they diminish or increase vital energy, are greatly under the influence of *medicinal substances*. We can by their exhibition produce various degrees of sleep or of wakefulness; and we can also diminish or increase the sensibility of particular portions of the nervous system.

There are different channels by which these medicinal substances may be employed to act upon the nervous system—the alimentary canal, the lungs, and the skin. It matters not whether camphor, ammonia, or ether be received into the stomach, inhaled by the lungs, or absorbed by the skin; for in whichever of these modes they are administered, their effects on the cerebro-spinal system are precisely similar.

Neurotics.

Neurotics form a very important class of medicinal bodies, and have been arranged according to the particular portions of the cerebro-spinal system which they influence. Hence there are those which assuage pain, or the *narcotics;* those which promote sleep, or the *hypnotics* or *soporifics;* those which allay irregular muscular contractions, or the *anti-spasmodics;* those which cause excitement, or the *stimulants;* and those which depress the energy of the nervous system, or the *sedatives.* But the practical imperfection of this classification has arisen from the same neurotic medicines acting either as hypnotics, narcotics, anti-spasmodics, or sedatives; these different effects chiefly depending upon the dose of the medicine which has been administered.

Soporifics.

Of these different effects of *neurotics*, there is none of more general application, and more useful than that which proceeds from *sleep.* A diminution in the waste of the body is as essential for its preservation as a due supply of the *incretions*, so that sleep, respiration, and digestion, may be considered to perform, as it were, synonymous functions.

Not only do most animals sleep during the night, but the regularity of the time for sleep appears to be as essential for the enjoyment of health as regularity in taking food.

Those who are accustomed to sleep at a particular hour, when they are prevented from obeying the impulse, are seldom equally refreshed by a future slumber. Alluding to sleep, the immortal poet has truly said,—

> "Do not omit the heavy offer of it,
> It seldom visits sorrow; when it doth,
> It is a comforter."

Shakspere.

The benefit of sleep;

The greatest benefit of sleep, or the rest of the mind, seems to be derived when the slumber is complete, and when we awake at such a moment when there is no inclination for more sleep.

Quantity of sleep necessary.

However essential sleep may be for preventing the waste of the body, the quantity which is required by different persons is very considerable; and, if the usual quantity of sleep be not daily obtained, we generally suffer, more or less, from the want of it.

Its hurtful effects.

On the other hand, "sleep, continued for too great a length of time, disposes to all the disorders that are caused by slowness of circulation; to fatness, drowsiness and cachexia; and is highly detrimental to the memory."

Haller.

Hurtful effects are also caused by imperfect and interrupted sleep. This is precisely what is observed regarding food—the regularity of the meals, as well as the moderation in their quantity, being essential for perfect digestion.

Gratification derived from soporifics.

In no disorders are the good effects of sleep more strikingly exemplified than in those of the heart; and, in the disorders of this organ, the moral influence of sleep is the more remarkable, the heart's functions being so much under the influence of the mind. Such, indeed, is the gratification derived from the use of neurotics, especially that of opium, tobacco, and alcohol, that man, in his most uncivilized state, and in every part of the globe, possesses some narcotic, in which he indulges in preference to all other sensual gratification.

Curative effects of sleep.

The beneficial effects of *soporifics* are not only to diminish the waste of the body during sleep, but they are also the means of subjugating disease. In this respect, sleep and syncope are analogous in their effects upon the economy; the great diminution in the vigour of the circulation during sleep being, as in syncope, the means of subduing or of checking the progress of inordinate vascular action. On this principle I would explain the curative effects of *neurotics*, such as *opium*, in many diseases.

Soporifics

Having shown that, during perfect sleep, it is requisite that the vigour of the heart's action should be diminished, it may be anticipated that *watchfulness* will frequently be a necessary consequence of an increased circulation; and, therefore, to promote sleep in those afflicted with a disordered heart, such means should be adopted as may be best calculated to tranquillize the circulation. This observation, however, applies chiefly to those who have a disorder of the *systemic* heart, and to those in whom sleep is prevented, from an increase in the proportion of the arterial blood in the brain; whereas, in diseases of the *pulmonic* heart the excess of venous blood in the head causes drowsiness, stupor, and coma.

Having formerly explained the phenomena by which sleep is preceded, accompanied, and succeeded, we are now prepared, not only to give a satisfactory explanation of the various remedial means which promote sleep, but we are enabled to establish rules for employing them, in those who are suffering from a disordered circulation.

Moral soporifics.

The means by which we can promote sleep are both moral and medicinal. There is no more powerful neurotic than the *mind*, for whether it be over-excited or depressed, its influence in causing wakefulness is equally remarkable.

> "My slumbers—if I slumber—are not sleep,
> But a continuance of enduring thought
> Which then I can resist not; *in my heart*
> *There is a vigil, and these eyes but close*
> *To look within.*"
>
> Byron.

Those who are much occupied in worldly pursuits generally have their sleep more imperfect than those who are engaged in literary or scientific investigations. Nothing contributes more to induce sleep than occupying the mind with some cheerful or some frivolous recreation before retiring to rest. On this principle, have arisen many habits for promoting sleep, such as reading works of fiction, those unconnected with our more serious pursuits, or such as create little interest. Monotonous sounds, too, as the humming of bees, the noise of a waterfall, and the sound of "sweet music," all contribute to produce sleep.

There is, however, no soporific equal to mental fatigue, provided always that it has not been carried to excess; for it is the same with the mind as with the body, any great mental excitement causing restlessness and preventing sleep. Wellington, I have been told by an eye-witness, fell into a profound sleep the moment he lay down upon a couch, after the battle of Waterloo; and even before he could undress himself!

Soporific medicines.

Sleep may be also procured by the exhibition of those medicines which diminish the action of the heart. *Hypnotics*, according to Hippocrates, produce sleep "by calming or by giving rest to the blood." The account which I have given of the nature of sleep accords with this opinion of the father of medicine.

Opium, *hyoscyamus*, *belladonna*, *aconite*, *digitalis*, *ammonia*, *camphor*, *hydrocyanic acid*, and *chloroform*, are all in their turn employed to promote sleep by their influence in tranquillizing the heart's action.

Besides promoting sleep, *neurotics* are also employed in disorders of the circulation, for their *narcotic*, for their *anti-spasmodic*, and for their *sedative* effects.

Opium.

Opium.—Of that class of medicinal substances, there is no one which has so long and so justly been extolled as *opium*. The neurotic effects of opium are employed to procure sleep, to allay pain, or to diminish the vigour of the whole nervous system.

Its soporific effects.

As a *soporific*, opium has been universally had recourse to; and its powers of tranquillizing the heart has made opium more frequently administered to procure sleep, than any other medicinal substance. For this purpose its good effects are generally produced by very small doses,—five or six drops of laudanum, combined with the acetate or carbonate of ammonia, the citrate of potass, or some laxative infusion, is the best mode of exhibiting it.

Its anodyne effects.

As a general rule, opium, in whatever form it is used, should be given either in very small or in large doses; the medium dose often deranging the system generally; to allay an irritable state of the circulation the small dose recommended as a soporific is sufficient. An eminent statesman, besides emphysema of his lungs, had an *atrophied* heart; the benefit he obtained from small doses of opium was remarkable. Alluding to his sufferings, he writes, "The relief is quite wondrous, and I could fall down and worship my opium pill like a Turk! What is new to me, indeed, I have got through the labours of my toilet with scarce any feeling of exertion, and I am altogether stronger and a better man than I have been a great while."

Memoirs of the Life of Francis Horner.

Its narcotic effects.

To relieve *pain*, opium should be given in full doses, and freely administered. "In the use of laudanum two things must be carefully observed. When once we begin with it after any evacuation, it must be given in a sufficiently large dose, and repeated often, to conquer the symptom; remitting only such a space of time between every dose as may be sufficient to inform us what the effect of the last hath had before we give another."

Sydenham.

Opium may be administered with great advantage in disorders of the heart, either singly or combined. When administered singly I know of no form preferable to the common crude opium; for it is with this, as with many other drugs, that when *purified*, and the medicinal part alone preserved, the effects are often altogether changed. Thus, neither *morphine* nor *narcotine*, taken separately, have the same effects as crude opium. One grain of morphine produces no more effect than two grains of opium; and these two grains of opium contain only one-sixteenth part of a grain of morphine. This observation applies to other neurotic medicines, as well as to opium.

Paris's *Pharmacologia.*

The influence upon the animal economy, which the combinations of elementary bodies, such as those which nature has formed in the vegetable kingdom, is also apparent in the combinations of various saline substances that are present in mineral waters: if such natural waters be decomposed, and deprived of any of their component parts, however minute may be the quantity of them, their effects are often completely changed. In the common epsom salts this is exemplified, for, if the muriate of soda from which they derive their bitter taste be taken away, their action on the alimentary canal is changed.

Effects of opium combined.

Most men of experience agree, that, when combined with some saline medicine, opium seldom causes that disturbance in the system, such as headache and mental irritability, which are so common an effect of opium or laudanum, when taken singly. Hence the reputation of the Dover's powder, and of the modes of combining laudanum with the citrate of potass, the sulphate of magnesia, or with ammonia: all which combinations are extremely useful when administering opium in disorders of the heart.

Crude opium, combined with *calomel*, is another formula, from which most benefical effects are derived in some disorders of the heart, especially in all those where the specific effects of mercury upon the system are desirable; such as in its inflammatory affections, and when it is thought advisable to give opium in sufficient doses to alleviate pain. In other cases, I am in the practice of giving only the few first doses of opium combined with calomel, when it is desirable to prevent any mercurial affection of the system, and afterwards giving it singly or combined with the antimonial powder, or James's powder. The combination of opium with *antimony* such as the antimonial, and more especially with James's powder, is a most useful formula.

Effects of digitalis.

Digitalis.—The effects of digitalis on the circulation are so powerful, that it has been called the "opium of the heart." At the same time the influence of this medicine and of opium on the heart is quite different; each is applicable to different conditions of the central organ of the circulation. In all inflammatory affections, after depletive measures have been employed, the irritable state of the heart is generally relieved by opium; but *digitalis*, like antimony, has so decided an effect in diminishing the heart's action far below the natural standard,[1] that in those maladies where its vigour is already much diminished, digitalis must be administered with great caution; its effects being in such cases to diminish still further the nervous energy.

The hurtful effects of digitalis are remarkable in all cases of atrophy and dilatation of the walls of the pulmonic heart, and where there is a great prostration of strength; and also in those cases where the aortic valves are diseased, and the blood regurgitates into the ventricle, a greater rather than a diminished power will be necessary for the ventricle to carry on the circulation; in all such cases digitalis is injurious. But in those diseases, where the action of the heart is increased, and where the propriety of diminishing it is indicated, then digitalis often produces the best effects; the subdued action of the heart which follows its exhibition diminishes the force of the vital stream in the thoracic viscera.

Besides its *neurotic* powers, digitalis, taken singly, or combined with a mercurial, is a powerful *diuretic*, promoting the action of the absorbents, and increasing the secretion of urine; and hence its utility in removing effusions in the pericardium.

However judicious we may be in selecting appropriate cases of affections of the heart for its exhibition, yet digitalis is one of those medicinal substances, the action of which is very uncertain. It frequently excites nausea, and even vomiting, irritates the mucous membrane of the alimentary canal, and, in place of diminishing, it increases the heart's action. It is also one of those medicines whose effects are sometimes *cumulative*, such as colchicum. Examples are recorded where repeated doses of these medicines having been administered without any sensible influence, until so large a quantity had been ultimately given, that when it began to affect the system, its action had been so violent as to destroy the patient.

All the good effects of digitalis, as of many other medicinal bodies, is usually obtained by giving it in small doses, these being readily absorbed; whereas a larger quantity passes through the alimentary canal, and produces comparatively little effect. Half a grain of the powder, five drops of the tincture, or half an ounce of the infusion of digitalis, repeated every twelve, eight, or six hours, will generally be found sufficient in those cases of disordered circulation where its exhibition is appropriate. When there is an effusion in the pericardium, then a small dose of the powder, combined with one or two grains of the common mercurial pill, and one of the squill pill, frequently repeated, and continued for some time, acts in many cases as a most powerful absorbent and diuretic. Digitalis may also be absorbed by the skin, and, where its exhibition is required, it has been recommended to apply a few grains of the powder upon a newly blistered surface.

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[1] A case is recorded by Barth and Roger, in which the pulse was reduced to twenty-five beats in a minute by digitalis.

Boulleaud.

Effects of belladonna.

Belladonna.—The influence of belladonna on the nerves of the iris, as well as upon other portions of the nervous system, affords a remarkable illustration of that great therapeutic law which I have mentioned, that the effects of medicinal molecules are confined to particular portions of the cerebro-spinal system. On the action of the heart the influence of belladonna is likewise very powerful; and although it has not been so much employed as some other *neurotics* in the treatment of diseases of the circulation, yet there are cases wherein its beneficial influence has been most decided.

Case communicated by Mr. Glen.

" A young lady, after a severe mental affliction, had a violent affection of the heart, the peculiar features of which were paroxysms of syncope accompanied with convulsions; after a variety of remedies had been tried in vain, she experienced a most extraordinary relief from the external application of belladonna. When the extract in solution was applied to the nape of the neck, it mitigated the symptoms almost immediately : she ultimately became so expert in using it, that she knew the precise quantity to apply; and whenever the requisite influence of the medicine was produced, being unable to speak, she made a sign with her finger to her attendant to discontinue the application. In this way she continued to suffer several years, and always received the same relief from the belladonna."

Hyoscyamus.—Like other neurotics, hyoscyamus influences some particular portions of the cerebro-spinal system, and in the same manner as belladonna makes its impression upon the iris.

Hyoscyamus, when given in certain doses, sometimes disturbs the functions of the *retina*, causing various imperfections in vision.

The influence of hyoscyamus upon the nervous system has been considered analogous to that of *opium*, and superior to opium by seldom causing headache, and in not confining the bowels. But in disturbances of the heart, hyoscyamus has never appeared to me to possess the advantages of opium; nor has it, as far as I have been able to perceive, a specific effect on the *cardiac* nerves to recommend its use in any particular disorders of the heart.

Effects of tobacco.

Tobacco.—Amongst neurotic plants, besides opium, belladonna, and hyoscyamus, there are others, as *tobacco*, *colchicum*, *aconite*, *lettuce*, and the *nux vomica*, which are composed of several different elements: each of which, when employed separately, acts upon a different portion of the nervous system. This has been distinctly ascertained with regard to *tobacco*, one of its ingredients, the *nicotine*, acting upon the nervous system, and another, its *essential oil*, acting upon the heart; and thus it can be satisfactorily explained how those who chew tobacco have their nervous system influenced by it, the saliva becoming impregnated with the *nicotine;* and how those who smoke have the heart disturbed from the essential oil which is evolved in the combustion.

Brodie, *Phil. Trans.*

Thompson's *Mat. Med.*

How far the powerful impression, which the essential oil of tobacco makes upon the heart, may be employed to alleviate any of its diseases, I have had no opportunity of ascertaining.

These effects of some neurotics illustrate, what seems to be another important therapeutic law, to which I formerly alluded, that medicinal substances not only act upon particular systems of the animal economy, and that different effects are produced by different doses of them, but that some medicines contain several distinct elements, each of which acts upon separate systems and portions of a system. The practical lesson which this law gives is, that we should employ the elements of such medicines either separately or combined, according to the particular system of the economy upon which their remedial properties are required.

There may be observed also another striking analogy, in addition to that formerly mentioned, of the action of medicinal bodies upon the economy to the phenomena of disease. For, as diseases commence in one system, or in one tissue of an organ, and extend, according to their violence and duration, to other systems and to other tissues, so it is with medicines,—they make their impression successively upon one system after another, or upon one tissue of an organ after another, according to the dose in which they have been administered.

Effects of colchicum.

Colchicum.—Besides the action of *colchicum* on the nervous system and its influence upon the heart, it has also a powerful effect on the mucous coat of the alimentary canal, on the skin, and on the kidneys; so that when it is employed in the treatment of diseases of the heart, whether singly or combined, it acts not only as a *neurotic*, but it increases the mucous secretions of the intestines, the excretion of urine, and the cutaneous perspiration. These varied effects of *colchicum* explain the benefit, which is derived from its administration in some of those cases of disordered circulation, in which the digestive apparatus, and the vital fluid itself are variously deranged; as in gout and rheumatism; in both which diseases the action of the heart is generally much disturbed.

In the maladies where colchicum is to be employed, either in the form of wine, of tincture, of an extract, of the acetate, or of the powdered root, its effects are greatly modified, and more beneficial results obtained, when these preparations are combined with magnesia, or with a neutral salt, as the sulphate of magnesia, the acetate of ammonia, or the citrate of potass.

Scudamore, on gout and rheumatism.

From five to ten drops of the colchicum wine, given with three drachms of the sulphate, and half a drachm of the carbonate of magnesia dissolved in a bitter infusion or in peppermint water, is a most excellent formula. In the small doses it has usually a very decided effect, and answers most purposes for which colchicum may be required in the treatment of diseases of the heart. Large doses of this medicine, and doses frequently repeated, are often very injurious; their evil effects in *gout* seem to be produced by the derangement which they create in the circulation, as well as in the organs of excretion.

Effects of strychnia.

Strychnia.—Besides those vegetable neurotics that have been mentioned, I may allude to the influence of the *nux vomica*, as this violent medicine acts, not only upon the nervous system in a very peculiar manner, but likewise on the organs of circulation. The powerful action of *strychnia* on the *motor* column of the spinal cord, is a remarkable illustration of the effects of particular medicinal bodies on particular portions of the cerebro-spinal system. In the same manner as we have diseases of particular portions of that system, so we have medicinal substances to remedy them: of this, the curative effects of *strychnia* in the paraplegia caused by lead is a striking example. Of any curative virtues which strychnia may possess in diseases of the heart, I have no experience; but it is by no means improbable, that from the extensive manner in which it was employed by the earlier physicians in the treatment of insanity, epilepsy, and other nervous diseases, its reputation arose from its action upon the heart.

Effects of camphor.

Camphor.—There is no more valuable *neurotic* medicine employed in the treatment of some disturbances of the heart than camphor. When received into the stomach, it causes an immediate impression upon the gastric nerves, which afterwards extends over the whole nervous system. The power which camphor possesses in tranquillizing inordinate actions of the heart has led to its being employed as a *soporific.* In nervous palpitation, and in that irritable state of the heart which so often succeeds depletion, camphor may be had recourse to as a powerful *antispasmodic.* Combined with opium, ammonia, or valerian, camphor is a useful adjunct in those cases where the use of these medicines is indicated.

Effects of ammonia.

Ammonia.—Besides the impression which the *carbonate of ammonia* makes upon the gastric nerves, and which is afterwards communicated to the nervous centre immediately after it has been received into the stomach, it has a very decided influence also upon the heart, and it is perhaps the most powerful medicinal body that we possess for restoring the action of the heart when it has become feeble.

Effects of ether.

Ether is also a powerful neurotic, and its effects as an *anæsthetic* agent have brought it into much repute; for although its influence on the organs of circulation, as well as on the nervous system, has long been established, yet its great virtue of destroying the sensibility of the *sensory column* of the spinal cord, and the practical application of that quality to allay pain, has only been of late years appreciated. Besides its extraordinary narcotic powers, ether is a powerful *antispasmodic* and *sedative*, and, as such, is a valuable remedy in some disorders of the heart.

Effects of chloroform.

Chloroform.—The effects of chloroform on the nervous system are very similar to those of ether, not only in destroying the sensibility of the sensory column of the spinal cord, but in acting as a *soporific* by its influence in tranquillizing the heart. For this purpose eight or ten drops of chloroform, rubbed together with two drachms of the mucilage of gum-arabic, to prevent its evaporation, is a sufficient dose to promote sleep. Like other powerful medicines of the same class, great caution is requisite in its administration, when there is any change in the heart's structure. In the fatal cases which are recorded, where it had been resorted to in order to allay the pain of an operation, death was occasioned by the interruption which the chloroform had caused in the circulation of the blood within the heart, whose functions and structure had been previously changed.

Effects of alcohol.

Alcohol.—The effects of alcohol in restoring the heart's action, during a fit of syncope, and the instantaneous impression which it makes, whenever it enters the stomach, is a proof of its power upon the cardiac nerves; its influence is even prolonged after it is absorbed and conveyed into the blood.

Effects of prussic acid.

Hydrocyanic acid.—This acid is remarkable for its effects in diminishing the sensibility of the nervous system, without destroying the circulation; for when life is instantaneously and completely extinguished by this acid, the heart has been seen palpitating. Magendie.

Hydrocyanic acid is universally acknowledged to be one of those *neurotics*, which, however violent may be its effect when given even in a small quantity, may with proper caution be usefully administered. From two to five drops of the diluted acid (Scheele's) is a powerful remedy in some disorders of the heart.

As a *soporific*, it may be often given advantageously to those persons whose heart is irritable, and its beatings so violent as to be felt when in bed.

Granville's *Treatise on Prussic Acid.*

There are other disorders of the circulation, where this acid acts as an *antispasmodic.* In coughs and embarrassments in respiration where it has been found beneficial, the good effects have, in all probability, chiefly arisen from its influence on the circulation, which in such cases had been deranged.

Concluding remarks.

In concluding these therapeutic observations, I may briefly remark that, although all the neurotic medicinal substances produce effects on the animal economy in many respects analogous, yet in others their influence materially differs ; and it is only by experience that we can learn how, and under what circumstances, each should be employed as a remedial agent in the maladies of the heart.

Differences of alimentary and medicinal substances.

I may also here observe, that no line of demarcation can be distinctly drawn between *alimentary* and *medicinal* substances : such a division must be considered as merely arbitrary. The same instinct which guides animals in the selection of their food, also impels them to eat substances which *we* denominate medicinal. We consider the "bitter extractive," the muriate of soda, and acid vegetables, to have medicinal properties; and yet animals partake of them, at times, along with, or as part of their aliment, so that what is poison to one race is the food of another.

The tissues composed of the elements of medicines.

Chemical science having revealed that the elements of the animal kingdom are all to be found in the vegetable and mineral kingdom ; and having also shown, that particular substances contain the same elements as particular animal compounds, is it not therefore probable, that the substances used as medicines produce special effects upon particular organs, and that, when conveyed into the system, they assimilate and combine each with some particular animal tissue? This inquiry opens a most interesting field of research ; and its success will assist the pathologist in selecting the medicinal agent which he should employ according to the tissue which is diseased.

To me this appears to be a legitimate induction from what is already known of the formation of animal substances. It is perfectly well understood, in feeding animals, that different kinds of food are employed according as it is desirable to accumulate *fat* or *muscle.* Cattle are fattened by feeding them upon those vegetables that contain the largest proportion of *starch* and *sugar;* whereas the muscles of the horse are increased by feeding him upon such grains as oats, which contain the largest proportions of the *phosphate of lime.* It is the starch and the sugar that contain the elements of fat, and the phosphate of lime is the essential ingredient of muscle. Recent chemical investigations have shown that opium contains elements which are identical with the cerebral pulp. These observations accord with what I formerly noticed, when alluding to the mutual dependence which animals and vegetables have upon each other; animals living upon vegetables, and the excrementitious matter of animals becoming the food of plants. Liebig.

Dermatics.—The *cutaneous nerves* are a most important channel for the administration of neurotics; for besides the application of medicinal substances upon the surface of the skin, there are remedial means of a physical character, which can be employed to influence the cerebro-spinal system by their operation on the cutaneous nerves.

All the medicinal bodies which act upon the nervous system, when received into the stomach, produce analogous effects when they are applied to the cutaneous surface. In the treatment of the diseases of the heart, much benefit is often obtained by applying remedies on the cardiac region in the form of plasters and in embrocations; for, in addition to their local effects, it happens, not unfrequently, that the medicine which deranges the digestive organs, when received into the stomach, produces the best effects, when applied on the integuments of the chest.

The physical remedies which act upon the cutaneous nerves are friction, percussion, titillation, electricity, and acupuncturation.

Friction and Percussion.

Effects of friction.

The influence of *friction* and *percussion* on the cutaneous nerves in exciting the circulation is well known; and are valuable remedies in those persons whose capillary circulation is languid: we may observe their curative influence in many neuralgic diseases, and especially in some kinds of rheumatism. "When Captain Cook arrived at one of the Friendly Islands, he was seized with rheumatism, which was attended with acute pain;

but he was soon relieved by gentle friction, a treatment which the islanders usually employed."

Effects of titillation.

Titillation.—Still more powerful is the influence of titillation in producing changes in the circulation. When carried beyond a pleasurable sensation, it causes *laughter;* a convulsive movement which marks a change in the condition of the heart, and which may become so violent, as not only to cause pain in the cardiac region, more or less severe, but also to bring on a complete convulsive paroxysm. How far titillation might be employed for the treatment of disorders of the heart, I am unable to say; though it seems extremely probable, that it may be a means of remedying some derangements in the circulation.

Effects of galvanism.

Electricity.—The cutaneous nerves are a channel for the employment of electricity as a curative means in some disorders of the heart; the *magnet* has also been strongly recommended by Laennec for the treatment of its neuralgic affections.

Case communicated by Mr. Faxon.

"A young lady, who had been eagerly employed for several weeks with a difficult musical composition, was suddenly seized with what appeared to be a fit of common hysteria, but which terminated in a total loss of consciousness. Having submitted to many different kinds of treatment for upwards of ten months, her case was considered hopeless. She at this time had the appearance of a breathing statue rather than a living being,—tall and delicately formed, the eyes closed, the extremities cold, the pulse slow and moderately full, respiration natural, the muscles rigid; the extremities would remain for a considerable time in whatever position they were placed. She ate and drank with an apparent appetite, but without opening her eye-lids. She had occasionally an involuntary discharge of urine and fæces. The pupils were always permanently dilated, and not influenced by the strong light. She bore pricking with a needle and pinching without giving any evidence of suffering pain; and in no instance was there any appearance of her suffering, except when she was submitting to a course of electricity which was at this period of her illness resorted to as a forlorn hope. She had been eleven months in this extraordinary state when I commenced the electric treatment, causing a current to pass along the spine from the occiput to the sacrum, then along the extremities, and lastly through the brain. During the first fortnight of the treatment there appeared but little change, excepting a restlessness not observed before. The use of the magneto-electrical machine was discontinued from the evident pain it produced. I then employed only frictional electricity, and after twenty-five applications of it her family were astonished, hearing her say in a most doleful tone, that she was better. From this moment, after nearly twelve months' silence, she progressively recovered by the electrical treatment."

Acupuncturation is another remedial measure, which has undoubtedly a great influence upon the nervous system, and has also a decided effect in relieving some neuralgic diseases; but how far the effect of this operation on the cerebro-spinal system may prove beneficial in diseases of the heart, by its influence upon the cardiac nerves, I have had no experience to enable me to form an opinion.

Derivatives.

Having endeavoured to give a general view of those medicinal substances which influence the excrementitious and incrementitious processes, and also the nervous system, and of their curative effects in the diseases of the heart, there yet remains another class of remedies that here merits consideration—derivatives.

The metastasis of diseases.

One of the most constant effects of a disordered circulation is an *irregularity* in the supply of the vital fluid to the different parts of the body; in some organs the natural quantity being increased, and in others diminished in a corresponding degree. The important physiological fact, that, for the due performance of the various functions, changes in the supply of blood to the different organs are constantly taking place, according as more or less blood may be required for performing their functions, and the beautiful contrivances employed for thus regulating the circulation, have been fully pointed out. But in disease, and when changes in the supply of blood have no longer a salutary influence on the various organs, it then becomes an important therapeutic point to determine when to apply such remedies as will assist in regulating the quantity of blood to the different organs.

The translation or *metastasis* of disease affords another example of a curative process employed by the animal economy, which we have the means of imitating, and by which we can remedy the pernicious effects of a disease, by removing it from a vital to a less important organ. This remarkable pathological phenomenon has ever been considered as a valuable curative indication: for whenever nature *translates* a disease from a vital to a less important part of the body, it seems to be one of those beneficent laws of the economy which we should always endeavour to imitate.

Curative effects of derivatives.

In *arthritic* and *rheumatic* affections of the heart, it often happens that this process is resorted to by the economy; the symptoms being, in many instances, immediately alleviated by the arthritic or rheumatic inflammation suddenly affecting one or more of the joints of the extremities. In like manner, *eruptive* diseases and *abscesses* make their appearance in many instances in order to relieve internal diseases.

Case of George IV.

We observe the same pathological phenomena, when the body has received a *wound* or injury, the injured part soon participates in the particular condition of the system, at the time when the injury was received. The cautious surgeon takes advantage of this in recommending operations, always avoiding them when there is any tendency to a paroxysm of *gout*, and when they become urgent making use of sinapisms and blisters on distant parts, in order, by the counter-irritation which these create, to prevent the gout from being *translated* to the wounded part. It was from a want of this precaution that George the Fourth's life was in jeopardy; a tumour having been removed from the scalp whilst he was suffering from gouty inflammation of the knee. The gouty inflammation was translated from the left knee to the integuments of the head a few hours after the operation; serious apprehensions were entertained of the result, until, after a few hours, the knee fortunately became inflamed, and at the same time the arthritic inflammation completely disappeared from the head.

Derivatives enumerated

Derivatives are a valuable class of remedies in the treatment of diseases of the heart; and, as I shall point out in a subsequent part of this work, that the inflammatory affections of the heart are almost universally of a gouty or rheumatic character, we are enabled by derivatives to translate such maladies from the heart to less important parts.

This curative process performed by derivatives may be accomplished by remedies applied, either to the cutaneous surface, or to its subjacent cellular tissue. By the application of *rubefacients* on the extremities, such as mustard, turpentine, or cantharides, we increase the action of the cutaneous capillaries, and we endeavour to imitate nature's curative efforts by *vesication*, *pustulation*, and by creating inflammation and *suppuration* in the subcutaneous cellular tissue by *setons* and *issues;* and also by the *cautery* and *moxa;* remedies which were all familiar to Hippocrates.

Effects of medicines from continuity.

Besides the observations that have been made on the different manners in which medicinal substances act upon the body, I may briefly mention another mode by which some dermatic medicines appear to produce their peculiar effects. I allude to that action of medicines which is produced by the *continuity* of organs; for the medicine which is applied to one part of the body does not always limit its action to that superficies which it covers, but extends its influence to the tissues underneath, and likewise to organs deeply situated. These effects are produced by a common poultice, when it is applied to the integument covering a diseased liver or kidney; hence the effects, from contiguity, of warm drinks on diseased lungs when passing down the æsophagus or entering the stomach; and likewise from the use of cutaneous remedies when applied to the cardiac region in disorders of the heart. Now this *radiating* effect of a medicine bears a striking analogy to the radiation of diseases,—a disease which commences in a small lymphatic gland involves during its progress, sooner or later, the contiguous cellular and cutaneous tissues.

Barbier, *Mat. Méd.*

Recapitulation.

Having concluded these general observations on the remedies employed for the treatment of diseases of the heart, it may be expedient to recapitulate briefly the chief points that have been discussed.

1*st*, I have endeavoured to show that Nature is possessed of powers, not only to regulate and preserve, but likewise to restore disturbances in the circulation.

2*dly*, That these powers consist of certain instinctive processes performed by the animal economy.

3*dly*, That we possess artificial means, by which we can imitate some of these instinctive processes.

4*thly*, That these instinctive processes ought to be considered legitimate guides to direct us in the treatment of diseases.

5*thly*, That these processes are either *mechanical* or *chemical*, and are under the immediate influence and control of the *vital* principle.

6*thly*, That the *mechanico-vital* processes consist in muscular movements, by which the quantity of blood, in the cavities of the heart, can be either increased or diminished.

7*thly*, That the *chemico-vital* processes are those processes by which the *incrementitious* products are separated from the food and air, and are conveyed to and mixed with the blood; and also those processes by which the *excrementitious* products are separated and discharged from the body.

8*thly*, That the same organs perform both the functions of incretion and excretion.

9*thly*, That when one of these organs is unable to perform its specific function, that function can be executed by one or more of the other organs.

10*thly*, That there are medicinal substances which have an influence upon one particular organ, or upon one tissue of an organ.

11*thly*, That by whatever channel medicinal substances are conveyed into the blood, their effects upon a particular organ or system are always the same.

12*thly*, That some medicinal substances are composed of several distinct principles, each of which acts upon particular organs or systems.

13*thly*, That there are effects produced by some medicinal substances which have a strict analogy to the phenomena of disease; many diseases, like medicinal substances, affecting only one organ, or one tissue of an organ, and afterwards extending to other tissues and to other organs.

14*thly*, That the different tissues which form the animal fabric are composed of different elements; and that each of these elements is contained in the different kinds of food, as well as in certain medicinal substances.

15*thly*, That the substances received into the stomach and lungs yield, not only elements, which are required for the formation and reparation of the different tissues, but also principles which regulate and restore the animal functions.

16*thly*, That the vital processes are essentially different from the mechanico-vital and the chemico-vital processes.

17*thly*, That in the vital processes no decomposition nor any new combination is formed.

18*thly*, That these processes are executed by the vital power, through the medium of the nervous system.

19*thly*, That the vital processes are, each, executed by different portions of the nervous system.

20*thly*, That the vital processes are all under the influence of medicinal substances.

THE DISEASES OF THE HEART.

CHAPTER XXXVIII.

CLASSIFICATION OF THE DISEASES OF THE HEART.

First attempts at classification.

The desire to arrange and classify the multiplied objects with which man is surrounded, and which may be easily traced from the first dawn of civilisation, can also be found in the earliest works on physic. The resemblance which some diseases have to each other in their general character, in the regions of the body in which they are met with, and in the particular organs which are affected by them, must have led to something like a rational mode of their classification.

It was long, however, before anything like a methodical system of *nosology* was formed; and whilst medical science remained fettered and encumbered with erroneous theories and hypotheses, many diseases were grouped together and arranged in the same class, order, genus, and species, from mistaken opinions of their nature, of the causes which were supposed to produce them, or of the system of the economy in which they were supposed to be situated.

How the diseases of the heart may be classified.

In classifying the diseases of the heart, the arrangements which have hitherto been made are in many respects extremely complicated; so that in place of rendering the disorders of this important organ readily understood, and a knowledge of them more easily acquired—the primary objects of nosology, they tend rather to embarrass and confuse medical science. To me, it appears that the diseases of the heart may with propriety be classed according to the same general principles on which the diseases of other organs have been so clearly and simply arranged. I allude to their division into the *functional* and *organic*.

However advantageous this classification may be for practical purposes, and in no organ can such be more legitimately made than in the heart, it must nevertheless be considered arbitrary; for it is quite impossible to draw a definite line of demarcation between the two classes, or to affix a precise boundary to each of them; and it is clear, that there must be many different phases of a disease, from the first functional disturbance, to the formation of morbid changes in any of the heart's tissues.

The distinctive characters of the two classes is, however, sufficiently apparent from the examination of diseased parts after death; although in those organs which the naked eye can reach, changes during life often become invisible after death. If a limb, where a sanguineous congestion, which has been produced by the application of a ligature around it, be macerated in water, it loses every vestige of disease. Whereas, if an extremity which had suffered from inflammation be treated in the same manner, its form remains unchanged, a sero-albuminous fluid being deposited in its tissues. Functional disorders of the heart, like those of other organs, such as the alimentary canal and skin, exhibit, on dissection, no vestige of disease; whereas, in the *organic* diseases, some morbid alterations are detected after death; although changes in the tissue that existed during life, may after death have completely disappeared.

The *functional* disorders of the heart, include those wherein there is a disturbance of the circulation, either from changes in the *quantity* of blood within the cavities of the heart,—from an interruption to the *entrance* of the venous blood,—to the *exit* of the arterial blood; or from changes in the *quality* of the blood. They arise likewise from *vital* causes, or from that *sympathy* which exists between the heart and the other systems of the economy; and they may also be produced by changes in the functions of *both*, or of *one* only of the hearts.

The *organic* diseases comprehend all those maladies wherein there is an appreciable change in the structure of any of the heart's component tissues; an arrangement formed according to those physiological principles, which were first adopted in classifying the organic diseases of other organs of the body by the ingenious Pinel and Bichat.

Nosographie Philosophique.

Leçons Pathologiques, par Bichat.

Besides being divided into those diseases affecting particular tissues, I have subdivided the organic diseases of the heart into the *idiopathic* and the *specific;* and into those of the *systemic* and of the *pulmonic* heart; for diseases are not only limited to one tissue, but they are also limited to one heart, and seldom affect both.

Diseases cannot be legitimately divided into the *acute* and *chronic;* these terms signifying merely different stages of the same malady.

TABLE OF THE DISEASES OF THE HEART.

FUNCTIONAL DISEASES.

- Blood changed in
  - Quantities.
    - Congestion
    - Syncope
    - Anemia.
  - Qualities.
    - Palpitation from
      - Chlorosis.
      - Jaundice.
      - Morbus Cærulius.
- Cardiac Congestion.
- Systemic Congestion.
- Pulmonic Congestion.
- Coronary Congestion.
- Pulmo-cardiac Congestion.
- Sympathetic affections from
  - Cerebro-spinal Irritation.
  - Digestive Irritation.
  - Pulmonary Irritation.
  - Genito-urinary Irritation.
  - Cutaneous Irritation.
  - Angina.

ORGANIC DISEASES.

- Diseases of Different Tissues.
  - Sero-fibrous Tissues.
    - Pericardium.
      - Pericarditis, . . .
        - Idiopathic.
        - Arthritic.
        - Rheumatic.
        - Exanthematous.
      - Dropsy.
      - Puriform Effusions.
      - Ossification.
    - Endocardium.
      - Endocarditis, . . .
        - Idiopathic.
        - Arthritic.
        - Rheumatic.
        - Exanthematous.
      - Albuminous Effusion.
      - Ossification.
  - Muscular Tissue.
    - Atrophy.
    - Hypertrophy.
    - Softening.
    - Inflammation.
    - Abscess.
    - Fatty Degeneration.
  - Coronary Vessels.
    - Arteries.
      - Inflammation.
      - Ossification.
    - Veins.
      - Varix.
  - Adipose Tissue.
    - Morbid Depositions of Fat.
- Systemic Heart. / Pulmonic Heart. } Diseases of,
- Idiopathic and / Specific. } Diseases.
- Rupture and Lacerations.
- Aneurism.
- Malformations.

CHAPTER XXXVIII.

THE CONGESTION OF THE HEART.

General observations on the functional diseases of the heart; this subjec-neglected; its extent and importance; peculiarity of the heart's functional diseases; these are derived from the peculiarity of its natural functions; the phenomena, causes, symptoms, and diagnosis of congestion.

General observations on functional diseases.

BEFORE entering upon the subject of *congestion*, I may remark, as regards functional diseases of the heart in general, that in the works which have professedly treated of the diseases of this important organ, little notice has been taken of its *functional* disorders, far less have any minute researches been made into their nature; this is the more surprising, as such affections are both numerous and of frequent occurrence, and most of them are remediable by medical treatment. Indeed, there can be no more satisfactory evidence of the frequency of the heart's functional disorders, than the numerous changes of the arterial pulse,—these always indicating some corresponding change in the function of the heart.

It is not, however, on all occasions, easy to draw a distinct line of demarcation between the natural and the diseased functions of any organ; for the same functions are performed both in health and in disease. Thus a person vomits in order to empty the stomach of deleterious food; and he also vomits, as an act of the economy, to assist in restoring the circulation during a fit of syncope. He respires to oxygenate the blood; and he breathes quickly to relieve a congested state of the thoracic viscera.

The morbid changes of the tissues which compose the heart present the same characters as those of similar tissues in other organs; but the disorders of the heart which are functional, are peculiar to the central organ of the circulation; the heart, like other vital organs, having its own special functional diseases.

The circumstance of the heart being neither an organ of secretion nor of excretion, but merely a receptacle for receiving, and having muscular parietes for propelling the blood into the proper vessels, produces an assemblage of particular symptoms whenever its functions are deranged; and, besides its action being unremitting, and its different cavities contracting and dilating in a particular order, are peculiarities in its function which must essentially modify its various diseases.

The Phenomena and Causes of Congestion of the Heart.

Having explained, when considering "the phenomena and causes of the diseases of the heart in general," the nature of its congestion, and the phenomena with which it is accompanied, the observations then made will serve as an introduction to what now remains to be said on this important subject.

It has already been observed, that the heart, in its natural and healthy condition, neither expels, during each contraction, the whole of its contents, nor does it receive, during each dilatation, all the blood which its cavities could contain.

It has been likewise shown, that differences in the *quantity* of blood within the cavities of the heart are almost constantly taking place during the performance of the natural functions of the body; and that, in order to regulate the quantity of blood in the cavities of the heart, the animal economy itself possesses certain means. I have also pointed out that, when any superabundant blood cannot be removed from the heart by these instinctive processes which are possessed by the economy, its cavities then become permanently in a condition which is by far one of the most frequent causes of disorders of the heart. This condition of the heart, which, in place of having been hitherto considered as a *primary* affection, or described as a distinct disease, has only been cursorily alluded to, in systematic works, amongst the *diseases* either of the *pulmonary*, or of the *nervous* systems; some authors having considered it as belonging to the former class, because of the cough, dyspnœa, and hæmoptysis, by which it is usually accompanied; and others to the latter

Their imperfect classification.

class, from its being attended by disturbances of one or more portions of the cerebro-spinal system.

Besides a congestion of the right and left heart there may also be a congestion of the *coronary*, or of the *pulmonary* vessels.

Coronary congestion.

I have said, that when the cavities of the heart become congested, a corresponding change must necessarily take place in the coronary vessels; for whenever there is any unusual increase in the quantity of blood in the left ventricle, from an increased velocity of the retrograde current of the aortic blood,—such as may be caused by a great muscular exertion, the coronary arteries will then participate in this additional supply. And the right heart being at the same time overloaded from an increased influx of the venous blood, the momentum of the stream from the coronary *veins* into the right auricle will be proportionably diminished. The consequence of these changes in the circulation of the coronary arteries and veins will be a permanent increase in the quantity of blood in both systems of vessels;—a condition which, in order to distinguish it from congestion of the heart's cavities, may be appropriately denominated *coronary* congestion.

See diseases of the coronary vessels.

From the preceding remarks it follows, that as there cannot be a congestion in the heart's cavities without a corresponding over-distention of the coronary vessels, we are entitled to infer, that the changes in the heart's action, when it is in a state of congestion, are not only produced by an increase in the quantity of blood within its proper cavities, but also by an increased quantity of the vital fluid in the coronary vessels.

Thus we are enabled to explain the symptoms of cardiac congestion,—their progress,—the changes of structure in the heart's apparatus, which is sometimes ultimately produced, and likewise the effects of that treatment which experience has found to be most efficacious; especially the benefit which is derived from *leeches* applied to the precordial region satisfactorily explains the vascular *anastomoses* of the coronary and mammary arteries. At the same time it must be taken into consideration, that whenever there is a congestion of the cavities of the heart, and also in the coronary vessels there will necessarily be an assemblage of phenomena, some of which must be referable to the congested auriculo-ventricular cavities, and others to the congested coronary arteries and veins.

Pulmo-cardiac congestion.

There will likewise be a congestion of the pulmonary vessels. The intimate relation that exists between the *lungs* and both the pulmonic and systemic heart, will, it is evident, cause any congestion of the cavities of the heart materially to affect the pulmonary circulation, producing what may be denominated *pulmo-cardiac* congestion.

In all temporary changes in the quantity of the heart's blood which are constantly taking place, and which are quite compatible with health, the lungs perform as important a share as the heart itself, in preserving and in restoring the balance of the thoracic circulation. The sobbing and sighing,—the deep inspirations,—the screaming,—the paroxysms of laughter,—the convulsions and the vomiting, so frequent in the hysteric paroxysm, are, I have fully explained, all instinctive acts by which the lungs, conjointly with the heart, restore the balance of a deranged circulation.

The same changes in the quantity of blood within the left heart that increase its action, cause an over-distention of the pulmonary vessels, and consequently the circumscribed distention of the air-cells produce an increased frequency in respiration. For the same reason, when there is congestion to such a degree that the powers of the heart alone are not sufficient to relieve it, and when the superabundant blood in the pulmonary vessels cannot be removed by any of those instinctive acts, or by those modifications in respiration which are possessed by the economy, then the pulmonary vessels remain permanently congested; respiration not only becomes embarrassed, but, in extreme cases, there supervene dyspnœa, cough, pulmonary hæmorrhage, and even suffocation.

Influence of congestion on the different systems.

Besides the condition of the pulmonary circulation when the cavities of the heart become congested, various disturbances arise, in consequence of changes in the distribution of the blood in other systems of the economy; especially in the *cerebro-spinal*, in the *digestive* systems, and in the *cutaneous capillaries*.

As the reciprocal dependence and co-operation in the functions of the *brain* with those of the heart are such, that whatever disturbs the functions of one of these vital organs, must influence those of the other; so we find in cardiac congestion, that whilst a corresponding engorgement takes place in the pulmonary vessels, the quantity of blood in the *cerebro-spinal* system is diminished, or at least there is a diminution in the proportion of the arterial blood in that system.

Causes of congestion.

The heart may become congested from several distinct and very different causes. Congestion may be caused by an inordinate muscular exertion; by mental emotions; by the application of cold or heat to the cutaneous or to the mucous surfaces; by suppressed evacuations; by changes in the structure of the heart; by general plethora; by an obstructed arterial trunk; by inhaling noxious gases; by poisons; and by changes in the lungs.

Congestion caused by Muscular Exertion.

Of these different causes of congestion, let us first consider that of *inordinate muscular exertion;* such being not only a frequent cause of congestion, but affording a satisfactory explanation of its phenomena, physiological as well as pathological, and likewise pointing out rational principles on which its treatment should be conducted.

It has already been explained, how the action of the heart is quickened by all kinds of bodily exercise, and its pulsations increased, both in frequency and in force, by muscular exertion.

It has also been explained, how every movement of the body has not only the effect of hastening the return of the venous blood to the pulmonic heart, but likewise the effect of retarding the exit of the arterial blood from the systemic heart; and that, consequently, by every muscular effort, the cavities of the heart become more or less distended with blood.

When, therefore, from an unusual muscular exertion, there is such an accumulation of blood or congestion in the thoracic viscera, that the person does not soon recover his natural tranquil and regular respiration; and when there is also a disturbance in the action of the heart, along with a hurried respiration, such as may be considered beyond the scale of health, these changes convey the notion of the most simple form of a congested heart.

A disturbance in the action of the heart from muscular exertion, it may be anticipated, will vary, not only in degree, but in duration; in some cases being so slight as scarcely to arrest attention, and to be merely transitory; but in other instances it proceeds to such an extent, and is so long continued, as to increase the thickness of the muscular parietes of the heart, or to lay the foundation of some permanent mischief.

Indeed, when the heart and the lungs have become so congested that they have not been relieved of all surplus blood, an increase in the impulse of the heart, and an embarrassment in respiration, may continue for any length of time; and in some instances, when the functions of the central organ have been much disturbed, the circulation is not perfectly performed, even throughout the remainder of life. Hence many of those who have been long affected with a disorder of the heart, can often trace its commencement to an unusual muscular exertion having been made at some more or less distant period.

But it is those who are not accustomed to take severe exercise, and who are not in what is called "good wind," who are most exposed to injure the heart by an unusual muscular exertion. The condition of the thoracic viscera of a person who is properly "trained," I have already endeavoured to explain; and without a previous knowledge of the *pulmo-cardiac* function, and of certain peculiarities in the structure of the lungs, no rational explanation could have been given of the great power which is acquired by some persons, by which they are enabled to perform various muscular movements; it being quite clear that the differences which different persons possess for running, dancing, reading aloud, blowing wind-instruments, and the like, do not depend alone upon differences in their muscular vigour. It is by modifications, which they instinctively make in respiration, by which they can not only execute muscular movements, which those who have not been "trained" are unable to perform; but they are also less susceptible of those disorders of the heart to which those who are not in equal "condition" are so much exposed.

Different causes of congestion.

Those whose avocations or whose amusements excite them to make unusual violent muscular exertions, such as *running*, *dancing*, *rowing*, *ascending a high mountain*, and also *singing and blowing wind-instruments*, and performing *feats of strength*, frequently suffer from congestion of the heart.

Chap. XXXVIII.

Congestion caused by running.

There is no more frequent cause of congestion than for a person running more quickly, or to a greater distance, than he is accustomed to.

A man, whilst running to catch a coach, fell down senseless, but soon recovered. When running on a similar occasion, he staggered and fell, and became very uneasy and unwell for twenty minutes afterwards.

A young lady induced to run quickly up a hill, did not recover her natural breathing until some weeks, when, finding the heart's action unnaturally vigorous, a few leeches were applied to the cardiac region, which, along with antimonials, restored the tranquillity of the circulation.

A student at Eton became so excited by a pack of hounds passing by him in full chase, that he was induced to run after them, which caused such a disturbance of the circulation, that he died fifteen months afterwards from disease in the heart.

By dancing.

Public *dancers*, too, being frequently impelled to make extraordinary muscular effort, often suffer from congestion of the heart.

Case communicated by M. Albert.

" A *danseuse*, after having been confined to her chamber by a temporary indisposition, and deprived during that time of her accustomed practice, was induced to make one evening a very great effort from the applause she met with at a crowded theatre. Her breathing became so much oppressed, and the heart beat so violently, that she was under the necessity of being assisted to her home. By great tranquillity these symptoms gradually abated, but she never afterwards recovered her natural breathing completely, so that she was compelled to retire from the stage."

By gymnastics.

Similar affections of the heart are likewise brought on by an improper use of *gymnastic* exercises.

Case.

A youth, who was a pupil at a school in Switzerland, where gymnastic exercises were practised to a very great extent, was sent home on account of a congestion of the heart, brought on by the violent muscular exertions which he had been compelled to make.

By rowing.

Sailors, when exposed to excessive bodily exertion, in *rowing* a boat, and in situations of danger, often suffer from congestion of the heart; and there are instances of boatmen who, in rowing " matches," have suddenly expired. Of all amusements, rowing is, perhaps, the most frequent cause of a disordered heart; and this no doubt arises from young men, particularly at our public schools and universities, being incited to make exertions, when rowing matches, beyond their strength, especially when they had not previously undergone the requisite "training."

Case. A youth made the most violent efforts to win a rowing match, in which he succeeded. The action of the heart was much disturbed, and for several years afterwards it remained in an irritable state.

Those whose avocations expose them to violent muscular exertions, are also subject to similar ailments.

Case. A chambermaid, when carrying coals up-stairs, often became so breathless as to be obliged to sit down and rest; and it was usually some time before she could again begin to ascend the stairs with her burthen. After having suffered some weeks, she then complained of considerable difficulty of breathing, with a great increase in the impulse of the heart. By applying a few leeches four times, and taking a dose of James's powder every night, she soon recovered.

But cardiac congestion, as I have already stated, sometimes proceeds to such an extent as to injure the heart's structures, and to cause even a rupture of its parietes, or of the trunks of the great vessels within the pericardium, of the valves especially, when these have been previously diseased. In some instances, the *column* is torn asunder, and sometimes the *valves* themselves are lacerated.

Injuries of this description happen not unfrequently. In all those cases, where persons have been attacked suddenly with giddiness, reeling, and syncope, after having made some unaccustomed or violent muscular exertion, and in whom the circulation is never afterwards perfectly natural, there is good reason to suspect, that one or other portion of the systemic heart has been injured. The mitral valve, torn and displaced, admits a retrograde stream of blood from the ventricle into the auricle; and when any such injury has occurred, the lacerated parts cannot adhere, as they are never in a state of rest; and all that the economy can accomplish, is to effuse fibrine sufficient to fill up, more or less perfectly, the aperture made by the laceration.

Case.

A woman fell from a window, and was found lifeless. The skull was fractured and depressed. On opening the pericardium, and removing a large quantity of blood, both the auricles and the right ventricle of the heart were found ruptured.

Case recorded by Corvisart.

A *courier*, after having suffered much fatigue from riding on horseback, was attacked with difficulty of breathing and hæmoptysis. Repeated blood-lettings, and other means, afforded no relief. His pulse became very small and contracted, remarkably frequent and irregular; and besides the pulsations of the heart, there was a confused irregular beating, which had no resemblance to the heart's movements. He could not rest in any posture, and "he was in a state of anxiety and agitation impossible to describe." After death, it was discovered that one of the columnæ of the *mitral valve* was torn at its base, thus allowing the valve to float freely in the cavity of the ventricle.

Case.

A young man made a violent effort to move a great weight, soon after which there came on cough, palpitations, and sudden startings during sleep. He died twenty months after, having suffered from great anxiety and difficulty of breathing, and severe pains in the region of the heart.

On examining the tendinous columns of the *mitral valve*, two of them were found torn, and all the cavities of the heart were considerably dilated.

Case recorded by Babington.

"A youth received a sudden shock from the unexpected discharge of a pistol close to his ear. He felt conscious that something gave way in his heart, and from that time suffered from palpitation, occasional syncope, with the usual symptoms of obstructed circulation; and he died of general dropsy at the end of eighteen months. The *mitral valve* was found obstructed by a fringe of excrescences, originating from a rupture of the valve itself, which had taken place at the time of the surprise."

When, from any powerful muscular effort, there is a strong regurgitating stream of aortic blood, it has happened that either the semilunar valves are torn, or when they have been able to resist the retrograde stream, the coats of the aorta have given way.

Case.

A man fell from a window upwards of forty feet high, and in an hour after he expired. On opening the thorax, the mediastinum was found filled with blood; and there were two fissures at the commencement of the descending aorta, through which the blood had escaped.

Case. A youth, after a debauch, from which he experienced, on the following day, great weakness and derangement of the stomach, with a view of improving his condition, played at "tennis," which threw him into a profuse perspiration; and on making a violent exertion, he felt suddenly a giddiness and sense of swimming in the head, so that he could not stand or guide himself without difficulty. He was bled at the arm, and notwithstanding every means employed, the same feelings in the head continued, along with a difficulty in breathing, and occasional syncope. These symptoms continued, varying in degree, for twelve years, and without any apparent cause he expired suddenly. On inspecting the body, an *aneurism* of the aorta, not larger than a walnut, had burst into the pericardium.

There is a change in the *lungs*, which has been observed in *animals* that have dropped down lifeless from cardiac congestion caused by extreme muscular exertion. Such an effect has not, that I am aware, been observed in the human body, though it may sometimes take place, and may account for a certain condition of the lungs of those persons who, from some over-exertion, never after recover perfect breathing. The change alluded to has been described by Sir Everard Home, and consists in lymph being effused into the air-cells; and I have found in animals which have died under similar circumstances, that blood has also effused immediately beneath the pulmonic pleura. *Phil. Trans.* 1827.

Congestion caused by Mental Emotion.

The influence of the mind upon the heart must have led the word *heart* to have been used in Holy Writ, and in common language, as synonymous with the moral sentiments. The powerful influence which the different passions have on the heart, renders this language not merely figurative; for it is strictly true, that mental emotions, which cause only a temporary change in the heart's movements, if often repeated, frequently lay in it the foundation of permanent disease. Indeed, on reviewing the numerous cases of affections of the heart which have come within my own observation, it is remarkable in how many instances they could be distinctly traced to some sudden violent mental excitement, or to some long-continued depressing passion.

No class of diseases appear to me more worthy of diligent investigation than that of the affections of the heart to which I have now alluded; being convinced that many diseases which ultimately destroy life can be traced to a moral cause, and might, as I shall endeavour to show, have been subdued by an early and judicious treatment. The powerful influence of the mind on our physical frame ought surely to be a useful lesson to medical men in the *moral* treatment of the sick, especially of those who have any disorder of the heart; instances being daily met with, of persons suffering much mental disquietude, and of their diseases being greatly aggravated by receiving incautious opinions;—still more frequently by having been exposed to the empirical parade of a stethoscopical examination.

"If one doubted the fatal influence of the passions on the heart, it would be sufficient for him to know that it may be torn in fits of anger, and cause sudden death; and I am not the only person who considers that organic lesions were more frequent during the days of the Revolution, than during the ordinary tranquillity of social order." Corvisart.

When inquiring into the causes of the diseases of the heart in general, I remarked the differences in the effects which were produced by the *exciting* and by the *depressing* passions; the exciting emotions increasing the impulse and sounds of the heart, whilst the depressing passions diminish the intensity of both its impulse and of its sounds.

Congestion caused by the exciting and depressing passions.

If the impulse of the heart be increased by the *exciting* passions, an additional quantity of blood is congested in the left heart, in consequence of the violent muscular movements which the passion excites; whereas, in congestion caused by the *depressing* passions, the quantity of blood being increased in the right heart, the action of the heart is diminished, and the whole frame becomes motionless and prostrate. "Fear is characterized by feebleness throughout the whole vascular system, preventing the blood reaching the capillaries, and causing that general paleness, remarkable particularly in the face." Bichat.

Congestion of the heart from either of these causes, is met with in every possible degree. Instances have been already mentioned where sudden death was caused by mental emotions; and when the passion has been so violent as to extinguish life, the death was, in one case, the effect of an increased circulation of the cerebro-spinal system, and, in the other, of congestion in the heart itself.

Congestion caused by laughter;

Laughter, the attribute only of man, being one of those instinctive acts which the economy employs to invigorate the heart—the phenomena by which it is accompanied afford an excellent illustration of the operations of the *musculo-cardiac* function—the muscular movements which accompany it increase the quantity of the heart's blood. It is by thus invigorating the circulation that we can explain how mirth and laughter are useful auxiliaries in promoting the digestion of the food.

To preserve a healthy condition of the body, this influence of *laughter* appears to be essentially useful; but laughter, when carried to excess, produces effects which are equally hurtful, causing violent convulsions that are followed by such a degree of cardiac congestion as the *vis conservatrix* cannot overcome; and also an engorgement of the heart, which may not only become permanent, but may even endanger life. The common expression of a person having "fits of laughter," and being "convulsed with laughter," are, therefore, pathologically correct;—they are links of one chain of phenomena, and are the effects of different degrees of congestion of the heart.

Case)

A gentleman had an immoderate fit of laughter, which lasted upwards of an hour; after the laughing had ceased, it was succeeded by a violent *hiccup*, which continued during the whole night and the following morning. He then complained of a distressing sense of choking and oppression on the sternal part of the throat, besides the hiccup, with a strong impulse of the heart, and a sensation of fulness and tenderness on pressure. Four leeches were applied to the precordial region, which bled profusely, and after taking a few doses of the tartrate of antimony, he recovered.[1]

and by bodily pain.

Congestion is also caused in those who are suffering great *pain*, and who make an effort not to give it expression. By such an effort the economy is prevented from performing those acts of crying, screaming, weeping, and violent muscular movements, by which the impetus of the blood in the heart is increased; and the power of the heart to circulate the blood has thus been often so greatly diminished, and the congestion such, that it has been followed by immediate death:

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[1] "Two men who were at work in a field near Boulogne, in the environs of Paris, with a young girl, amused themselves by tickling her feet as she lay upon the grass. The girl laughed heartily for a time, but convulsive movements of the chest succeeded. She rose from the ground, but immediately fell again and expired."—*Britannia*, Sept. 20, 1845.

> "Give sorrow words; the grief that does not speak,
> Whispers the o'er-fraught heart, and bids it break!"

Shakspere.

Congestion caused by Extreme Cold or Heat.

Congestion from cold applied to the digestive canal.

The sudden application of extreme cold to the *mucous* membrane of the stomach, by drinking very cold water, or eating "ice," more especially at a time when the body has been overheated, is frequently the cause of cardiac congestion, and has been in many instances followed by serious and often fatal consequences. But even if the body has not been over-heated, eating "ice" frequently produces a most distressing pain in the region of the heart, and sometimes the disturbance caused in the circulation is followed by violent headache and even epistaxis.

The effects of *cold* on the circulation, whether it be applied to the cutaneous or to the gastro-pulmonary mucous surface, are equally remarkable, causing a diminution of blood in the cutaneous capillaries, and probably a similar effect on the mucous membranes of the intestines, along with a corresponding increase of blood in the vascular system of the interior of the body, more especially a congestion in the thoracic viscera.

When noticing the influence of *cold* on the mucous membrane of the digestive canal, as causing disturbances of the heart, allusion was made to a case where its effects were suddenly fatal, merely from the introduction of some iced water into the rectum in order to relieve hæmorrhoids; the sudden death being, in this case, doubtless caused by congestion of the heart, in the same manner as those who perish from the congestion which is caused by the exposure of the whole body to intense cold.

Case.

A man of middle age, being very much heated from dancing, drank a tumbler of "iced water." Half an hour afterwards he experienced a sensation of numbness in the face, a cold chill, followed by a profuse perspiration, palpitation of the heart, difficulty of breathing, noise in the ears, and a dimness of sight which in a few hours amounted to blindness. These feelings all abated during the night, but recurred suddenly in three days, and lasted a quarter of an hour. This person had similar attacks once or twice a week for two years.

Congestion from cold applied to the lungs.

Equally pernicious are the effects of suddenly breathing very cold air on the *pulmonary* mucous membrane; the heart, as well as the lungs, become thereby congested, even before any *inflammatory* symptoms supervene.

The effects of cold on the mucous membrane of the lungs are no less remarkable, than on the mucous membrane of the digestive canal. This we see exemplified by the almost instantaneous effects which, breathing cold air, has in causing general fever; and from the contiguity of the mucous membrane of the bronchi with the tissues which compose the lungs, there is frequently a cough and other pulmonary symptoms.

When the heart is previously diseased, the effects of congestion from cold are often extremely dangerous. The pulmonary mucous membrane is, in such cases, very susceptible of inflammation; so much so, that we seldom find the heart diseased without some accompanying redness of the lining of the bronchi. At other times the application of cold increases the derangement of a heart that has been previously disordered.

Congestion from cold applied to the cutaneous surface.

The effects of exposure to cold upon the *cutaneous* surface, are, in many respects, analogous to those which cold produces on the gastro-pulmonary mucous membrane.

Congestion of the heart is not unfrequently caused by *cold bathing;* especially in those who are suffering from a disturbed circulation; therefore, it is always proper to ascertain the condition of the heart before making use of the bath.

Case.

A gentleman of a gouty diathesis had a painful sensation in the heart, which came on after bathing in the sea, and which continued for several months. The impulse of the heart was increased, and the arterial pulse was small: this disordered state of the circulation yielded to antimonials, which also relieved the uneasy sensations in the heart.

Congestion, caused by cold bathing, sometimes proceeds so far as to check altogether the transit of the blood through the heart, and extinguish life.

Case.

A gentleman was advised to bathe in the sea; the moment that his legs were immersed in the cold water he fell down lifeless.

The influence of the exposure of the body to severe cold, in diminishing the quantity of blood in the cutaneous surface, and in congesting it in the internal viscera, is well known; hence the benefit which, those suffering from cold derive from keeping the limbs in motion, which by the influence of the *musculo-cardiac* function, accelerates the circulation of the blood. Such was the method recommended by Xenophon to the Greek troops, in the memorable "Retreat of the Ten Thousand."

It is by no means unusual to hear of persons who have suffered great indisposition from sleeping in a *cold* and *damp bed:* instances are not very rare where the effects have even proved fatal; I have already mentioned cases of this kind. See p. 156.

The first effects of sleeping in a damp bed are perceived upon the skin, deranging the functions of the cutaneous capillaries; this derangement of the capillaries is accompanied by a corresponding change in the circulation of the whole sanguineous system. Besides the general chilliness and coldness of the cutaneous surface, there is much inequality in the heat of different parts of the skin, the natural temperature never being restored throughout the whole body at the same time; this condition may continue, not only for days and weeks, but even for months after the exposure.

To these effects upon the cutaneous capillaries there succeeds a congested state of the heart, marked by an increased impetus in its movements, and by a feebleness of the arterial pulse. In consequence of the congestion, there often comes on cough of a spasmodic character; in many cases, too, the pulmonary mucous surface is inflamed. There are also headache, giddiness, or uneasy sensations in the head—restlessness—excessive debility of the whole muscular frame—local pains,—and very frequently an attack either of muscular or articular rheumatism. At the same time considerable derangement of the digestive canal ensues, of which there is no more remarkable symptom than nausea, with a peculiar brownness, and an increase in the *bulk* of the tongue.

The body protected from cold by the mind.

Here I may allude to the extraordinary power of the mind, which enables the body to resist cold by invigorating the heart; the same power which is so remarkable in enabling the body to resist disease.

"In the expedition of the Russians to Khiva, notwithstanding the intensity of the cold, the soldiers, flushed with hope of victory, marched along singing, with the breast of their coats open. But the same troops, after marching little more than twelve miles at a very slow pace, to gratify some whim of their commander, suffered severely, one-third of them being attacked on the succeeding day with a fever of which many died."

Sir G. Lefevre.

Extreme heat causes congestion.

Extreme *heat*, whether from hot substances applied to the skin, or to the gastro-pulmonary mucous membrane, may also cause congestion of the heart; of this I have mentioned two remarkable cases.

Besides those causes which have been enumerated, congestion may be caused by changes in the structure of the heart.

Congestion from plethora.

The heart also participates in that state of the sanguineous system where the quantity of the whole mass of blood exceeds the natural standard. The congested state of the heart which accompanies *plethora* is of a very different character from an idiopathic congestion; and there is no better diagnostic symptom of the two disorders, than the condition of the cardiac and arterial pulse; for whilst, in cardiac congestion, the heart's impulse is increased, and the arterial pulse diminished; on the other hand, in plethora, the vigour of both the cardiac and arterial pulse is increased.

Congestion from an obstructed artery.

Another cause of cardiac congestion, is when a large *arterial* trunk is obstructed as in the operation for the cure of aneurisms. It is this state of congestion of the heart, when left unsubdued, to which the failure of that operation may, in many instances, be attributed.

Congestion, caused by poisons,

Many of the vegetable and mineral *poisons* produce their fatal effects from the heart becoming congested by their influence on the cardiac nerves; the muscular powers of the heart being so enfeebled as to render the central organ incapable of circulating the blood.

and by noxious gases.

The inhalation of some *noxious gases* has likewise a powerful effect in causing a congestion of the heart; the congestion being, in such cases, produced by chemical changes in the qualities of the blood; the noxious effects of which diminish the heart's vigour, and render it incapable of freely evacuating its contents.

Congestion caused by suppressed Evacuations.

Congestion of the heart may be caused by the suppression of a habitual sanguineous evacuation, such as the menstrual or the hæmorrhoidal flux; by the sudden stoppage of the discharge of an old ulcer, or by an eruptive disease being too quickly healed.

Congestion caused by suppressed catamenia, &c.

Congestion may be caused either by the menstrual flux being suppressed, or by imperfect menstruation. The consent between the heart and the uterine system has been already pointed out; and I have endeavoured to show, that diseases of the heart often cause disturbances of the uterus, and that diseases of the uterus in their turn often create disorders of the heart.

When the *catamenia* are suppressed, the whole sanguineous system becomes more or less disturbed, and most of the symptoms are referable to a congested condition of the heart.

By checking the puriform discharge of a chronic ulcer, or suddenly healing an eruption, serious effects on the economy are often produced, and have sometimes led to fatal consequences; these effects being caused by changes in the sanguineous system.

"The idiopathic cases of suppression of the menses seldom continue long without being attended with various symptoms or disorders in different parts of the body, very commonly arising from the blood which should have passed by the uterus being determined more copiously into other parts, and very often with such force as to produce hæmorrhages in these."

Cullen.

Congestion caused by diseases of the lungs.

Congestion of the heart accompanies many diseases of the pulmonary apparatus; and of these, one of the most frequent is that which I have denominated *pulmo-cardiac* congestion; for although the slightest increase of the heart's blood is accompanied by an increase of blood in the pulmonary vessels, yet there is a class of cases where the circulation in the lungs is first changed, the disturbance of the circulation in the heart being the effect of that change in the lungs.[1]

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[1] "In the majority of cases of *diseased heart* it appears that the embarrassment of breathing arises entirely from the *accumulation of blood* in the *pulmonary* vessels, in consequence of the difficulty which it finds in re-entering the cavities of the heart, the natural organization of which is more or less injured."—*Corrisart*, p. 390.

One of the most frequent causes of *pulmo-cardiac congestion* is inflammation of the pulmonary *mucous* membrane, the effects of which is to congest the pulmonary capillaries. I do not allude to the obstruction, which is caused in the respiratory organs during the active stage of inflammation, but to that chronic inflamed condition of the mucous membrane, which in many cases continues long after all febrile excitement has subsided.

In such cases the diseased condition of the mucous membrane must have an influence, more or less considerable, on the pulmonary circulation, and, when long continued, it is accompanied by all the characters of pulmonary congestion ; so that a person who at the commencement of his ailment has only the usual symptoms of inflammation of the mucous membrane of the bronchi, has, sooner or later, superadded pulmo-cardiac congestion. I may repeat here, that as congestion of the heart usually accompanies congestion in the pulmonary vessels, so, in like manner, congestion of the pulmonary vessels is, sooner or later, accompanied with congestion of the heart.

The Symptoms and Diagnosis of Congestion of the Heart.

The *physiological symptoms* of congestion of the heart are derived from those changes in the functions of the cerebro-spinal, the pulmonary, the digestive, and the cutaneous capillary systems, which are caused by disturbances in the circulation of the blood ; and although, in the present state of physiological science, we are unable to discriminate and refer each symptom to the particular changes in the circulation, yet there are some of the symptoms which can be satisfactorily explained.

Symptoms derived from the cerebro-spinal system.

The symptoms of congestion which arise from the changes in the circulation of the *cerebro-spinal system* are of the highest consequence. Indeed, it is impossible to conceive any change taking place in the functions of the heart without causing some change of the circulation in the nervous system ; for as the nervous system has unusual means in order to secure it with a constant supply of the vital fluid, so will that system be equally liable to suffer, if the heart become disordered, except where there is any change in the structure of the brain and spinal cord ; the diseases of the vascular system must therefore be of a secondary nature, some *primary* disease always existing in the heart itself.

A "reeling" or "swimming in the head," a difficulty in balancing the body, ocular spectra, ringing in the ears, temporary disorder of the intellectual functions, are the most remarkable *cerebral* symptoms of a congested heart.

Congestion is also accompanied by disturbances in the circulation of the spinal cord, and either the *motor* or the *sensory* column may be affected; so that in one class of cases there is a change in the sensibility of the sensory nerves, and in another there are either convulsive movements, or a loss of power of those muscles which are supplied by the motor nerves.

It also often happens, when the heart is congested, that, not only is the circulation in the brain and spinal cord disturbed, causing the various symptoms which have just been enumerated, but the cerebral circulation is so much deranged, that *hæmorrhage* takes place within the head—hence the frequency of *cerebral apoplexy* in disorders of the heart.

The hæmorrhage within the head may arise, either from the exudation of blood from one of the serous membranes of the brain; from the choroid plexus; or it may be caused by a rupture of one or more of the vessels of the cerebral parenchyma; the comparative delicacy of the tunics of the cerebral arteries rendering them more liable to rupture from disturbances in the circulation than other arteries.

When cerebral apoplexy is caused by a disordered heart, it has been already pointed out, that one class of symptoms arise from derangement in the functions of the systemic, and another from derangement in those of the pulmonic heart,—a division of the symptoms which may be satisfactorily explained by comparing different cases of apoplexy, the effect of cardiac congestion.

In the brain, as in other organs, there must be a constant change in the comparative quantity of the two bloods; and according to these changes must the symptoms vary. If the pulmonic heart be congested, all the symptoms, such as lethargy, embarrassed respiration, the varicose condition of the sub-cutaneous veins, and the slow and easily compressed arterial pulse, point out the deranged state of the *venous* circulation. On the other hand, when the *systemic* heart is congested, the symptoms are of an opposite character; headache, vertigo, ringing in the ears, ocular spectra, mental irritability, insomnolency, flushed countenance, with a vigorous pulse, all indicate a change in the *arterial* circulation.

But though we are able to refer some of these symptoms to the pulmonic, and others to the systemic heart, yet we cannot well conceive any considerable degree of congestion present in the one heart without some corresponding change in the other; and, therefore, the assemblage of the symptoms must be very different in the various phases of this disease.

Symptoms derived from the pulmonary system.

Of the physiological symptoms of a congested heart, none are more remarkable than those derived from the *pulmonary system;* for, whenever the cavities of the heart cannot empty themselves of any extra blood, such additional quantity becomes necessarily congested in the pulmonary vessels.

The provisions, with which the economy is endowed for preserving the balance of the circulation in the thoracic viscera may therefore be considered as the most unerring symptoms in disturbances of the heart. These instinctive acts of the economy are of two kinds; by the one the blood in the heart is *increased*, by the other the quantity is *diminished;* and what is of equal value to our pathological inquiries, is, that the different acts are each executed by different organs.

In this way we can satisfactorily explain, how one person cries, screams, laughs, hiccups, sneezes, or vomits, and has all the voluntary muscles thrown into convulsive movements—such acts contribute to increase the heart's blood, and may, therefore, be considered *symptoms* of a diminished vigour of the heart. In like manner, we can explain how another person sighs, sobs, and weeps, by which acts the surplus blood in an overloaded heart is forced into the lungs. The deep inspirations, by expanding the lungs, facilitate the ingress of the venous blood into the pulmonary arteries, and also assist the flow of the oxygenated blood into the pulmonary veins; the pulmonary vessels, being capable of sufficient distention to receive the superabundant blood, and to retain it until it is expelled by respiration.

Dyspnœa and asthma.

Dyspnœa and asthma are also symptoms characteristic of *pulmo-cardiac* congestion. The breathing may become more or less frequent, and the expirations are made with more difficulty than the inspirations. This disturbance in respiration varies at different times; sometimes coming in paroxysms, and readily produced by the slightest movements of the body.

These changes in respiration differ much from the difficulty in breathing, which is caused by an organic change in the lungs, such as tubercles. The "panting for breath," the short inspirations and long expirations are remarkable in those suffering from a congested heart; but when a portion of the lungs is incapable of oxygenating the blood, respiration becomes quickened, both the inspirations and expirations being shortened. The first of these conditions arises from the pulmonary capillaries being gorged with blood, thus rendering inspiration quicker than expiration; and the second condition arises from the portion of lung, which is rendered useless, causing respiration to be quickened so as to enable the sound portion of the lungs the more perfectly to oxygenate the blood.

Cough.

There is no more characteristic symptom of cardiac congestion than the *cough* by which it is often accompanied. It is loud, harsh, dry, and comes on in violent paroxysms. Sometimes, in place of being dry, it is accompanied by mucous expectoration; and when the paroxysm is particularly severe, which is usually the case in the morning when rising, it is accompanied by nausea and sometimes vomiting; the effect of which is to evacuate some pellucid and more or less glutinous fluid. The cough is often brought on by making even the slightest bodily exertion, especially by a change of posture, as in lying down, or rising up, or by walking up stairs; and paroxysms of coughing are also excited by changes in the temperature of the atmosphere.

Hæmoptysis.

A *spontaneous hæmorrhage* is one of the most frequent symptoms of a congested heart: the blood may be exhaled from the capillaries of any portion of the gastro-pulmonary mucous membrane;—from the pulmonary, from the nasal, or from the hæmorrhoidal vessels: as it cannot be supposed that blood exuded from each of these mucous surfaces, can have similar effects, or that each should be employed by the economy to mitigate the same morbid condition, we must therefore conclude that, according as the spontaneous bleeding takes place from the one or the other of these parts, it will indicate the seat of disease to be in the right, or in the left heart; and when artificial bleeding is to be resorted to, these different hæmorrhages are a safe guide to follow.[1]

The hæmorrhage which accompanies *pulmo-cardiac* congestion is remarkable for the large quantity of blood which is sometimes evacuated, and for the relief of the symptoms which it affords; but the bleeding is not always so very profuse, in some cases only a few ounces being evacuated in each attack.

"The quantity of blood expectorated is often enormous. I have seen a young man bring up ten pounds in the space of forty-eight hours, and expire at the termination of this period. In less acute cases, I have seen about thirty pounds of blood passed in fifteen days." Laennec.

It has already been noticed that *hæmoptysis*, though often considered as a symptom of ulceration of the parenchyma of the lungs, is frequently the effect of pulmo-cardiac congestion. Although the state of the thoracic viscera in such cases had not been explained, nor the pathognomonic characters of ulceration and of congestion of the lungs ascertained, yet, that two very distinct states of the thoracic viscera are accompanied by hæmoptysis, has been long known to pathologists.

"It has been commonly supposed that a *hæmoptysis* was naturally, and almost necessarily, followed by an *ulcer* of the lungs, but I will presume to say, that, in general, this is a mistake; for there have been many instances of hæmoptysis occasioned by external violence, without being followed by an ulcer of the lungs; and there have been also many instances of hæmoptysis from an internal cause without any consequent ulceration. And this too has been the case, not only when hæmoptysis happened to young persons, and recurred for several times, but when it has often recurred during the course of a long life." Cullen.

There is, indeed, no more certain diagnostic symptom of pulmo-cardiac congestion, than the relative *quantity* of blood, which is expectorated from congested lungs and from an ulcer: in congestion the bleeding is generally very profuse, whereas hæmorrhage accompanying ulcerated lungs, except in very far advanced cases, and where some large vessel happens to give way, is generally small.

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[1] Sometimes the effusion takes place immediately after the cause which produced the congestion, and in other cases it is a subsequent symptom. Such spontaneous hæmorrhage is very different in its character, from those which take place in consequence of ulceration of the pulmonary parenchyma.

Congestion of the heart may not only be accompanied by pulmonary hæmorrhage, but also by *pulmonary apoplexy*. In this disease there is an exudation of blood into the air-cells of the lungs; and from its resemblance to the sanguineous exhalation which produces cerebral apoplexy, it was denominated by Laennec pulmonary apoplexy.

"This alteration consists in an induration equal to that of the most complete hepatization of the lung, but also altogether different. It is always partial, and rarely occupies a large portion of the lung; its most ordinary extent is from one to four cubic inches. It is almost always very exactly circumscribed, and, at the point where the induration ceases, the engorgement is as considerable as towards the centre. The pulmonary texture around is quite sound. We sometimes see two or three similar engorgements in the same lung, and as often both lungs are affected at the same time in the same manner, these engorgements are generally towards the centre of the inferior lobes, or towards the posterior thin part of the lung." Laennec.

"The principal *symptoms* of this disease are great oppression, accompanied with much irritation of the larynx, and sometimes with acute pain in the chest; a frequent pulse, voluminous, and presenting a peculiar sort of vibration, even when it is soft and feeble; and this takes place often at the end of a few days. There is seldom true fever, and the heat of the skin is natural, or nearly so. Often the heart and principal arteries give a very marked hollow sound." Laennec.

Changes in the cutaneous capillaries.

Congestion of the heart is always accompanied by changes in the circulation of the *cutaneous capillaries*.

In proportion as the left heart is over-distended, so there is a corresponding *diminution* of the red blood in the cutaneous capillaries;—the face becomes pale, and the skin of the extremities bloodless and cold.

This condition of the cutaneous circulation in congestion of the heart, is admirably delineated by our immortal poet; and he has made the picture more striking, by contrasting a congested heart with the head congested from strangulation:—

"Oft have I seen a timely-parted ghost,
Of ashy semblance, meagre, pale, and bloodless,
Being *all descended to the labouring heart;*
Who, in the conflict that it held with death,
Attracts the same for aidance 'gainst the enemy;
Which with the heart there cools, and ne'er returneth
To blush and beautify the cheek again.
But see, his face is black, and full of blood;
His eyeballs further out than when he lived,
Staring full ghastly like a strangled man;
His hair uprear'd, his nostrils stretch'd with struggling;
His hands abroad displayed, as that one gasp'd
And tugg'd for life, and was by strength subdued.
Look on the sheets, his hair, you see, is sticking;
His well-proportion'd beard made rough and rugged;
Like to the summer's corn by tempest lodged.
It cannot be but he was murder'd here;
The least of all these signs were probable."

Henry VI.

The symptoms of congestion caused by *cold* are of the same general character as those from inordinate muscular exertion or mental excitement. The heart's impulse is increased, and the radial pulse diminished, the respiration is more or less embarrassed, the functions of the cerebro-spinal system are disturbed, especially those of the cutaneous capillaries.

Symptoms of congestion from suppressed discharges.

The symptoms of congestion of the heart caused by a *suppression* of the *menstrual flux* are also, in many respects, similar to those which are produced by cold, or by violent muscular exertion. There is the same increased impulse of the heart, and diminished force of the arterial pulse; and there is more or less disturbance of the pulmonary, of the cerebro-spinal, and of the capillary systems.

There is, however, a marked difference in the *history* of the disease; for whilst, in the first case of violent muscular exertion, the symptoms come on immediately on the application of the cause, whereas congestion from the suppression of the menstrual flux, or produced by cold, the progress is gradual; an observation which applies generally to congestion arising from the suppression of sanguineous discharges, and also from the drying up of ulcers and eruptions.

Symptoms derived from the digestive organs.

The *digestive organs* also afford symptoms of a congested heart. "Sickness at heart" is not merely a figurative expression, for it often happens that when the heart becomes congested, especially from mental affliction, nausea and vomiting supervene. In congestion from other causes, vomiting is by no means an unfrequent symptom.

Case.

A lady, from a sudden and severe affliction, vomited almost incessantly for ten days.

Symptoms derived from each heart.

In prosecuting these inquiries into the symptoms of cardiac congestion, however intimately blended the symptoms of each variety of the disease may be, we must expect to find an essential difference in the character of those symptoms which are derived from each of the two hearts.

It has already been pointed out, that there are great differences in the apparatus and in the functions of the pulmonic and systemic heart,—differences which enable a satisfactory explanation to be given of many phenomena in the diseases of each; as, indeed, nothing can differ more than the effects which congestion produces on the right and left hearts. Thus, when the *right* heart becomes congested, the stagnation of the venous blood will cause more or less congestion throughout the whole venous system; but in a congested state of the left heart, whilst the flow of the arterial blood from the lungs is impeded, the impetus of the arterial stream throughout the system is diminished.

Veno-pulmonary congestion.

The anatomical symptoms.

The most characteristic *anatomical* symptoms of cardiac congestion from an excessive muscular exertion are, an *increase* in the impulse of the heart, and a *diminution* in the vigour of the arterial pulse.

The increase in the heart's *impulse* arises from the parietes of the heart being preternaturally excited by the increased quantity of blood contained in its cavities; and the diminution, in the vigour of the arterial pulse, is the consequence of the left ventricle being unable to expel the blood with its wonted force. This condition of the circulation is of great practical importance, as it points out the propriety of examining, at the same time, both the cardiac and the arterial pulse, and thus enables us to adopt those remedial means for restoring the disordered circulation, which attention to the arterial pulse alone could not have suggested.

This increase in the heart's impulse is, generally, to such a degree as to be felt by the patient; the term *palpitation* being employed in common language to signify such increase in the beatings of the heart.

Sensibility increased.

Besides an increase in the impulse, there is, in many cases, an increased *sensibility*, and more or less tenderness of the heart's parietes: there is frequently a sensation also of fulness; to relieve which the patient makes an effort, by deep inspirations, but which he cannot altogether remove by any change in his breathing.

When the action of the heart is violent, it often causes more or less elevation of the intercostal muscles:—

> "Her bosom heaves
> With palpitations wild."
>
> Thompson.

Signs on percussion.

Changes in the sounds.

The *resonance* becomes dull over a large space of the chest, and the *sounds* of a congested heart are in the ratio of its impulse; for in those cases where the impulse of the systemic heart is increased, the audible sound is diminished; and when the congestion chiefly affects the pulmonic heart, the impulse is diminished and the sound proportionately increased.

Symptoms also arise in congestion, which may be considered common to both hearts; and it is to the numerous changes in the pulmonic and systemic circulation we are to attribute those pathological phenomena so constantly observed in the congested heart and lungs; the various changes in the functions of the two hearts causing endless combinations of the symptoms.

Symptoms in congestion, combined with diseases in other organs.

Besides the symptoms of congestion, which have been enumerated, from whatever cause a congested condition of the heart may have been produced, another order of symptoms arise when the seeds of a latent disease appear in some other organ. In those persons, who had previously been afflicted with a disorder, either of the heart or lungs, or of the brain or liver, these organs suffer in an aggravated degree, when congestion of the heart takes place, and the combination of the two ailments causes a new assemblage of symptoms.

Symptoms derived from changes in the blood.

But there is an order of symptoms in congestion which derive their origin from changes in the *qualities* of the *blood:* these take place when congestion has been caused by inordinate muscular exertions, or by violent mental emotions; and though we may not be able to discriminate such symptoms, it is extremely probable that the changes produced in the heart's functions by changes in the blood's qualities, become so intermingled with those symptoms which are produced by changes in its *quantities* within the cavities of the heart and in the coronary and pulmonary vessels, that we cannot expect such multiplied combinations of symptoms can be discriminated from one another by any physiological phenomena, far less by physical signs.

Reflecting on the numerous changes which are produced in the condition of the heart in the varieties of congestion, and on the different phases of the disease from differences in the causes by which it has been produced, as well as from the different compartments of the pulmonic and systemic hearts and coronary arteries which may be congested, we readily perceive how difficult it must be to analyse and explain the various combinations of the symptoms. On taking a retrospective view of the symptoms of this disease, there is not one of them, when taken separately, which may not be met with in other diseases of the thoracic viscera; so that it is only by examining the different combinations of them in each case, by which anything like a correct diagnosis can be formed.

In this investigation, we need surely expect to obtain little or no aid from physical signs; for, whatever changes may take place in the impulse, and in the sounds of a congested heart, such changes must have been hitherto considered, and have been included in the catalogue of the symptoms of other diseases of the heart: these difficulties satisfactorily account for many of the errors in diagnosis, which have arisen from relying on physical signs.

CHAPTER XXXIX.

THE TREATMENT OF CONGESTION OF THE HEART.

Bloodletting; rationale of its effects in the treatment of congestion; general and local bloodletting; when they are to be employed; curative effects of nausea and vomiting, sneezing and coughing; employment of medicines.

Treatment of congestion.

To establish rational principles for the treatment of congestion of the heart is of primary consequence. The frequency of this condition of the heart; the vital organs under its influence; its pernicious consequences when not subdued;—all show the importance of this branch of therapeutics.

The treatment of cardiac congestion consists in fulfilling two conditions; the one is to relieve the cavities of the heart and the coronary and pulmonary vessels from the superabundant blood; the other is to administer such medicines as will tranquillize the disturbed action of the heart, and also to restore the qualities of the blood.

Bloodletting, when to be employed.

To fulfil the first of these conditions, one of the most powerful means is *bloodletting*. In resorting to this remedy we are, I may repeat, strictly imitating a process which Nature employs to relieve congestion,—a *spontaneous hæmorrhage* often takes place at some period of the disease either from the pulmonary, from the ethmoidal, or from the hæmorrhoidal vessels, by which the symptoms are mitigated.[1]

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[1] "After so many evident instances of this, we can hardly doubt of the like powers taking place also in the more obscure internal parts, in many cases of disease which are *spontaneously* cured by the *operations of nature;* or, in other words, by the spontaneous powers of the animal economy, and particularly that the state of the circulation is often regulated so as to be excited to a stronger action, merely by the occurrence of resistance or debility. All this particularly applies to render it probable that the effect of sedatives, exciting the action of the system, either in general, or of particular parts, may be explained entirely by their being effects of a *vis medicatrix naturæ,* obviating injuries which threaten the whole system or particular parts; and to finish this subject, nothing can better show that active powers can be excited merely by a sense of

Rationale of the curative effects of bloodletting.

The curative effects to be anticipated from the abstraction of blood in cardiac congestion are also illustrated by the physiological and by the pathological views which have been given.

It has been demonstrated, that if the cavities of the heart be congested and unable to evacuate their contents with their wonted force, and that if a portion of these contents be removed, the power of the heart to expel the blood is immediately restored. Every one must have experienced the difficulty in voiding the first portion of urine, when the bladder has accidentally been much over-distended, and how the remaining portion flows in a much fuller stream, and requires a much less expulsive effort. This analogy is still further illustrated in the diseased condition of other muscular organs, such as the alimentary canal and the uterus.

The ingenious practice of Dieffenbach.

The same curative principle is admirably illustrated by the ingenious practice of Dieffenbach, who, attributing the failures of the Taliacotian operation to the portion of displaced skin sphacelating from a *congested* state of the cutaneous *capillaries*, perfectly succeeded in preserving the life of the displaced integument by keeping up a constant oozing of blood from the congested capillaries, applying in succession one leech after another until the adhesive process was completed.

In the treatment of cardiac congestion, caused by inordinate muscular exertion, bloodletting may be employed, either generally or locally.

When there is a great increase in the heart's impulse, and much embarrassment in breathing, especially if the disturbance of the circulation has been of short duration, *general bloodletting* ought to be resorted to, and a sufficient quantity of blood removed to tranquillize both the respiration and the impulse of the heart.

The blood should be allowed to flow as long as there is not any very sensible diminution in the impulse and in the sounds of the heart. *Syncope*, which is so powerful in subduing inflammatory

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debility, than this, that if a stimulus accustomed to support the activity of the system happen to be withdrawn, the sense of debility thence arising produces various actions in the system, or in particular parts. All these means of exciting the action of the system, or of particular parts, we name *indirect stimulants*.—Cullen's *Mat. Med.*

diseases, must be, in cardiac congestion, carefully avoided, and especially if the congestion be accompanied by any other morbid condition of the heart. It is in such cases where the too free abstraction of blood has been followed by pernicious effects, and led bloodletting to be deemed a dangerous remedy in diseases of the heart.

How the quantity should be estimated.

When a vein is opened, the radial pulse should be carefully watched, and though it may retain a certain force, yet whenever the ventricular contractions become feeble, no more blood should be abstracted. What opinion, then, can be formed of the discretion of a physician who orders a patient to lose any particular quantity of blood, with the same confidence as he would prescribe a dose of a medicine?

Local bleeding, when to be employed.

Leeches.

Unless the symptoms are urgent, *local* is preferable to general bloodletting; and the beneficial effect of *leeches* applied to the precordial region is very remarkable. By employing leeches the risk of too much depletion is greatly avoided; it will be almost invariably found that the bleeding from the leech-bites is in proportion to the fulness of the vessels. So that, as the bleeding is profuse, so will it be found useful. This effect of leeches, is one reason for preferring them to the operation of *cupping*.

Their derivative effects.

Leeches, too, must also have a *derivative* effect, when they are applied to parts at a distance from the heart, as upon the feet. In those cases of congestion, where their frequent repetition is necessary, after they have first been applied to the precordial region, they may, if repeated, be applied to the feet, and on subsequent occasions, to that part whence the bleeding will give most relief.

Other modes of diminishing the blood in the heart.

Besides the effects of abstracting blood, congestion of the heart is also to be relieved without removing any of the vital fluid from the system. This is to be accomplished, as has already been explained, by *dry-cupping*, *rubefacients*, *friction*, and the *pediluvium*.

Their utility explained.

As congestion of the cavities of the heart is accompanied by corresponding changes in the coronary and pulmonary vessels, the decided benefit derived from the application of leeches to the precordial region can, I am persuaded, be satisfactorily explained by the vascular *anastomosis* which subsists between branches of the *coronary*, the internal *mammary*, the *bronchial* arteries, and also upon the arteries of the *pericardium* and root of the *aorta.*

Curative effects of the instinctive acts.

In the treatment of those suffering from a congested heart, the various *instinctive acts* which are resorted to by the respiratory and circulatory organs, and which are such unerring symptoms in the heart's disorders, ought not to be disregarded. Of those instinctive acts, there are some which we have the power of imitating. We can increase the blood in the heart by muscular exercise and by titillation; we may change the respiration by swinging and rotatory motion; and we may cause *vomiting*, *sneezing*, and *coughing*—all which acts unload the heart.

How to be imitated.

But when we have not the means of imitating these instinctive processes, by which the loaded heart may be relieved, they should not be interrupted, but allowed to take their course; and those acts which increase the blood in the heart, ought to be equally guarded against. The pernicious effects of the restorative processes when checked, such as sometimes happens in consequence of their being under the influence of the *will*, are so well known that not only medical records abound with illustrations, but its evil effects have not escaped the poet:—

> "She never told her love,
> But let concealment, like a worm i' the bud,
> Feed on her damask cheek."

Shakspere.

Curative effects of vomiting,

As the act of *vomiting* is frequently resorted to by the economy for restoring a disturbed circulation, so it may be employed to relieve the heart when it has become congested; and there is no indication, which points out the propriety of administering an *emetic*, more than nausea or vomiting.

and of nauseants.

Of no less consequence are *nauseants* in the treatment of congestion. The influence of nausea upon the heart has been fully explained; its powers of diminishing the vigour of the circulation renders it a most useful remedy in the treatment of congestion of the heart.

To produce nausea there is no medicine more generally applicable than the preparations of *antimony;* the mode of administering them I have already mentioned.

Treatment of the consecutive symptoms of congestion.

During the treatment of cardiac congestion a period will sooner or later arrive when it is expedient to discontinue the use of depletion and antimonials, or, at all events, to give them only in such doses, and at such intervals, as will not create nausea; and only as long as they have a decided effect in alleviating the symptoms of the disorder.

This being accomplished, the heart often remains more or less irritable, the impulse is diminished, the sounds become less intense, the pulsations are more frequent, and the radial pulse is feeble and tremulous. These symptoms may be occasioned either by a disordered state of the muscular parietes of the heart, which may have been present from the commencement of the congestion; or they may depend upon changes in the *qualities* of the blood, or both causes may be combined.

Use of neurotics,

The irritable condition of the heart's parietes will be subdued by the administration of *neurotics*, and the state of the blood will be improved by *hæmatic* medicines.

Of the *neurotics*, opium, belladonna, digitalis, camphor, and ammonia, are all calculated to tranquillize the heart; the mode of administering them has already been fully explained.

and of hæmatics.

In cases of congestion where the *blood* is altered in its qualities, the *mineral* and *alkaline* medicines should be employed. Indeed, the beneficial effects derived from the use of hæmatic medicines after a depletive system of treatment has been adopted, and followed by neurotics, confirm the truth that the qualities of the blood were changed in such cases of cardiac congestion.

Dietetics.

The management of the *diet* of those suffering from a congested heart is of great consequence; for such is the intimate relation between the heart and stomach, that the slightest impropriety either in the quality, in the quantity, or in the regularity of a meal often deranges a healthy circulation. Hence it becomes imperative for a person who is suffering from cardiac congestion not to partake of food either of a quality, or in a quantity that cannot be perfectly digested.

Stomachics.

With respect to *stomachic* medicines, they are generally hurtful in cardiac congestion. Bitters and astringents are pernicious, not only during the congested state of the heart, but also when it becomes irritable after the symptoms of the congestion have been removed. The disturbance which these medicines create in the vascular system of the alimentary canal is communicated to the central organ, increasing instead of allaying its irritability.

Dermatics.

The cutaneous surface is likewise a channel for the exhibition of some remedies in congestion. Warm and cold *bathing* in their various forms, *rubefacients*, and *blisters*, and the local application of *plasters* composed of *opium* or *belladonna*, are all useful remedies. The mode in which they are to be employed in the treatment of diseases of the heart, has already been pointed out.

Of no less importance in the treatment of cardiac congestion, is the regulation of the *excrementitious processes;* the explanation which has been already given of the use of *purgatives*, *sudorifics*, *diuretics*, and *expectorants*, is strictly applicable to their administration in the treatment of congestion.

Curative effects of artificial respiration,

Though the influence of respiration on the action of the heart has long been known to physiologists, from inhaling noxious vapours, and from the influence of poisons, I am not aware of artificial respiration being much resorted to as a therapeutic agent, except in cases of congestion from drowning, or suffocation. When John Hunter on one occasion found that his heart ceased to beat, he made a great effort to inspire, and the circulation was restored. I have alluded to the case of a man who was brought up from a coal-pit apparently lifeless, and who was completely recovered by artificial breathing and venesection.

and of vomiting.

The beneficial influence of vomiting upon the action of the heart explains the common practice of *miners* taking an emetic whenever they have inhaled a noxious gas.

The observations, which have hitherto been made on the treatment of congestion, apply chiefly to that congestion which has been caused by some inordinate muscular exertion and by mental emotions; but it is evident that the treatment must be modified according to the cause by which the disorder has been produced.

Treatment of congestion from amenorrhœa.

Congestion of the heart, arising from a *suppression* of the menstrual flux, may usually be relieved by bloodletting, combined with those medicines which have a specific action on the uterine system, and which relieve and regulate the *catamenia*.

As a general rule, the most effectual mode of restoring the suppressed menstrual flux is to employ the chief remedial means one or two days previous to the usual time when it should appear; for there is doubtless a greater effort made by the economy at the approach of that period, than at any other to restore the discharge, and therefore the curative measures are then assisted by the *vis medicatrix*.

"It commonly happens in the cases of suppression that though the menses do not flow at their usual periods, there are often at those periods some marks of an effort having a tendency to produce the discharge. It is, therefore, at those times especially, when the efforts of the system are concurring, that we ought to employ the remedies for curing a suppression; and it is commonly fruitless to employ them at other times, unless they be such as require some continuance in the use to produce their effects." Cullen.

With regard to the abstraction of blood, two or three leeches should be applied to one of the feet the day previously to that on which the re-appearance of the flux is anticipated. The quantity of blood abstracted by the leeches will vary exceedingly; the wounds sometimes yielding but a small quantity, and at other times the profuseness of the bleeding from so few leeches will appear surprising.

A few days before the arrival of the regular period, it is also of importance that the *primæ viæ* should be completely unloaded. At the same time, it is advisable to use those purgatives which act on the large bowels, and which more or less irritate the rectum and uterine system, such as *aloes*, the local irritation of that medicine contributing, along with the other depletive means, to restore the uterine function.

Though the chief remedial measures should be administered immediately before the accession of the regular period of menstruation, yet attention ought to be always paid to the general health before that period arrives. There is usually more or less tumult in the heart's action, which the application of a few leeches to the cardiac region, and the pediluvium, and especially an emetic, will relieve. Any excited state of the cerebro-spinal system will be tranquillized by *ammonia*, *camphor*, and *galbanum*. The digestive apparatus should be regulated, taking pains to discriminate any derangement which might have existed previous to the cessation of the menses, and bestowing upon such a special management.

If the means employed be sufficient to restore the menstrual flux, that event will usually be followed by an alleviation of the

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disturbance of the heart, and according to the degree of the subsidence of the symptoms of the cardiac congestion, the future treatment must be regulated.

Should the impulse of the heart not be subdued, leeches may again be resorted to, and applied either to the cardiac region or to the feet, or the tartarized antimony, or James's powder may contribute to subdue the symptoms. But whenever the cardiac and arterial pulse are reduced in force, then *neurotic* medicines, such as opium, ammonia, camphor, may be administered, and continued as long as the heart's action is disturbed.

Treatment of congestion from a suppression of the hæmorrhoidal flux,

Precisely the same principles of treatment should be adopted in those cases of *veno-pulmonary* congestion which have been caused by a sudden stoppage of the *hæmorrhoidal* flux. The plethoric state of the *portal* system, which such hæmorrhages relieve, is a condition frequently so connected with a congestion of blood in the inferior cava vein, and a corresponding stagnation of the venous blood in the right heart, that whenever that system is not relieved by the hæmorrhoidal flux, a corresponding congestion is caused in the venous system, especially in the veins of the right heart.

or the sudden healing of an ulcer.

When cardiac congestion has been caused by the sudden healing of an old *ulcer*, or by the drying up of some *eruption*, not only are the symptoms to be relieved by depletion, but a return of the discharge from the ulcer, or of the eruption, is to be encouraged by the application of emollients, and the introduction of a *seton* or an *issue*. Cases are by no means rare, where a fit of apoplexy has been caused from the neglect of such treatment.

Treatment of congestion from cold,

The treatment of congestion from *cold*, whether it has been applied to the cutaneous, or to the gastro-pulmonary mucous surface, should have for its object to restore the balance of the circulation, by employing such means as will increase the quantity of blood in the capillary system. There is no remedy that will produce this effect so quickly and so effectually as an *emetic*. The tartarized antimony, rubefacients, friction, the pediluvium, and the warm bath, along with ammonia and camphor, are also to be administered; and though in some cases bloodletting may be advantageously employed, it should be resorted to with great caution.

and from heat,

That cardiac congestion, which has been caused by receiving into the stomach very *hot* substances, must require the same general treatment as when the congestion has been caused by cold drinks. The only remarkable case of this description, which has ever come under my own observation, has been already referred to. The spontaneous bleedings from the nose which took place so frequently, and for so many years in this patient, were, along with all the symptoms of congestion, relieved by the repeated application of leeches on the precordial region, along with antimonials and the preparations of iron.

and after amputation;

When the heart becomes congested from the stream of blood through an artery having been interrupted for the cure of an *aneurism*, or after a limb has been removed, great benefit will be derived from bloodletting; the *rationale* of which is quite apparent.

after the operation for aneurism.

Reviewing the numerous failures in the operations that have been performed for the cure of *aneurisms*, I am convinced that their want of success has, in many instances, arisen from the subsequent congestion of the heart and lungs; the pulmo-cardiac congestion having laid the foundation of those inflammatory attacks on the pulmonary system, to which the fatal result of these operations has been so frequently attributed.

After amputation.

The effects of the *amputation* of a limb upon the condition of the heart are, in many respects, analogous to a stoppage of the circulation in an arterial trunk; but with this difference, that in the operation of amputation, there is always more or less considerable loss of blood; whereas, a ligature may be placed upon an artery, and the operation causes but a few tea-spoonfuls of the vital fluid to escape. This remark applies, indeed, to all great operations; for in the majority of cases where they have proved fatal, death has been occasioned, not by inflammation of the wounded parts, but by an inflammatory affection of some vital organ.

From the passions.

The principles of treating cardiac congestion which has been caused either by the exciting or by the depressing *passions* are in many respects different; the increased action of the systemic heart in the one case, and its diminished action in the other, will require, it is evident, very different modes of treatment.

When the action of the heart has been disturbed from an *exciting* passion, the congestion may be relieved by the instinctive efforts of the economy; such as by sighing and weeping; but if the congestion be in a greater degree, then it will be subdued by the abstraction of some blood.

Walter S. Landor.

"When I hear one call upon another to be manly and to restrain tears; if they flow from the social and kind affections, I doubt the humanity, and distrust the wisdom, of the counsellor."

But an opposite system of treatment must necessarily be employed in those cases of congestion which are caused by the *depressing* passions. When the blood is congested from a diminution of the vital powers, in place of abstracting blood, which would still further diminish these powers, such cardiac medicines are to be administered as will increase the heart's vigour, and also such mechanical means as will increase the circulation. At the same time, we meet with cases, as I observed when considering the state of the sanguineous system in apoplexy, where both the arterial and venous systems are congested. The same assemblage of symptoms takes place in cardiac congestion, and similar principles of treatment should be adopted, both depletion and *neurotic* medicines being required.

From changes in the structure of the heart and lungs.

That congestion should be a frequent concomitant of alterations in the *structure* of the *heart* and *lungs* is not surprising, when it is considered, that such changes will have the effect of rendering the heart less capable of propelling the blood with its natural velocity. This accounts for the relief that is often obtained from a small depletion, even when there is extensive cardiac disease accompanied with general debility; or when there is congestion of the heart, in consequence of diseased lungs, and the pulmonary circulation is obstructed; such congestion may sometimes be relieved by the abstraction of a small quantity of blood.

Cases.

A woman, with tuberculated lungs, attended with great difficulty in breathing, and with all the symptoms of congestion of the heart, was bled a few days before her death. She experienced instant relief; and requested, two days before her death, that the bloodletting might be repeated.

A middle-aged man, in the advanced stage of pulmonary phthisis, when suffering from great oppression in his breathing, experienced much relief by applying a few leeches to the precordial region. The bloodletting not only diminished the increase in the heart's impulse, but it completely relieved a cramp in both legs, from which he had suffered every night, on going to bed, for six weeks.

It is when congestion takes place in consequence of some change in the heart's structure that depletion requires the greatest discrimination; the want of which has, doubtless, led in many instances to the improper use of bloodletting. The nicety in abstracting blood in such cases arises from the circumstance, that although the heart may be relieved, and the balance of the circulation be restored, yet if by abstracting the vital element the heart's stimulus be too much diminished, then follow those evil effects of depletion, which are so much to be avoided.

Concluding observations.

Conclusion.—In the account now given of congestion of the heart, I have been the more minute, because this interesting and important condition of the central organ of the circulation has never been pointed out as a *primary* disease; and its accompanying physiological and pathological phenomena have been only alluded to, in a very cursory and superficial manner, by all who have professedly given a systematic account of the diseases of that organ. The views, however, which I have offered, as well as the effects of the therapeutic measures, on which the pathology of congestion has been founded, will, I am convinced, establish the true nature of this disease, and point it out as one of the most frequent, as well as one of the most important of all the functional disorders of the heart. Nor could it have been anticipated, that any satisfactory explanation of this condition of the central organ could have been given, without a previous knowledge of the *three* important functions of the circulating apparatus;—the *musculo-cardiac*, the *pulmo-cardiac*, and the *veno-pulmonary* functions.

The observations which I have made on the *coronary vessels*, and on the morbid condition of these vessels, also open an entirely new and interesting field of investigation; one which has been most unaccountably neglected by those who have occupied themselves in investigating the diseases of the heart. The circumstance that neither cardiac congestion nor disturbances in the functions of the coronary vessels have ever been hitherto taken into account by pathologists, explains one cause of the numerous errors which have been made, in the diagnosis of the diseases of the heart, by those who ventured to draw conclusions from relying on physical signs.

It is not to be expected that any changes in the *sounds* produced by a congested state of the coronary vessels could be discriminated even by the most tutored ear; and no mention has ever been made of these sounds by stethoscopic observers: even had they been observed, it is by no means improbable that they have been attributed to other diseases, and confused with other sounds; thus rendering any *diagnosis*, founded upon such signs, totally fallacious. Now, how could we rationally expect, when the heart's vigour is increased, to be able to discriminate by physical signs, whether that increase arose from an increase in the number of the muscular fibres of the heart's parietes; from an irritable state of the internal suface of the heart; from an increase in the stimulating powers of the blood; or from some nervous excitement?

CASES

OF CONGESTION OF THE HEART.

With a view of further illustrating the nature of congestion of the heart, and of pointing out the numerous causes by which it may be produced, and also the principles of treatment by which the various phases of this important disease should be conducted, I have thought it expedient to add the following additional cases.

Cases of Congestion caused by Violent Muscular Exertion.

Case of congestion from running quickly.

Case I.—A young lady, unaccustomed to much exercise, was induced to run very quickly a short distance. This was followed by great embarrassment in breathing; she consulted a physician, who, conceiving that she was affected with catarrh, prescribed expectorants, without relief to the breathing or to the cough which supervened. When she came to London, I was struck with the peculiarity in her respiration, as she entered the room; on applying my hand to the chest, the impulse of the heart was found much increased, and there was tenderness to the touch in the cardiac region also, a slight agitation in the arterial pulse, with a short dry cough. The inordinate action of the heart was speedily relieved, and ultimately completely subdued by the repeated application of three leeches to the chest, antimonials, and strict attention to the digestive organs.

Case of congestion from running quickly, communicated by Mr. Noble.

Case II.—"An interesting youth was very imprudently induced to run after a squirrel, which he accidentally saw on a footpath, and so violent was the exertion which he made to catch it, that the effort was followed by intense pain in the cardiac region, accompanied with great embarrassment in breathing, and a swimming and uneasy feelings in the head. Five days afterwards he consulted me; he then complained of a good deal of uneasiness in the left side of the chest; the impulse of the heart was strong, and the radial pulse small and wiry; his respiration was imperfect, and he frequently sighed. Two leeches were applied to the cardiac region, the bite of one of which bled little, but from that of the other, blood oozed during twenty hours. A dose of James's powder was given two successive nights; on the third day the circulation was quite restored: after which he only complained of some uneasy sensations about the muscles of the back and neck, which were attributed to the exertion he had made when running after the squirrel; these, however, were completely relieved by two doses of Dover's powder. He continued well until three months after, when, in prosecuting some scientific researches in Switzerland, he ascended Mont Blanc, and on nearly reaching its summit his breathing became so much embarrassed, that he was compelled to descend the mountain, and it was not until after several days of tranquillity that he recovered his natural breathing."

Case of congestion caused by walking quickly.

CASE III.—A young lady, when in perfect health, walked quickly across Hyde Park, being a good deal excited by a crowd that was assembled there. Her breathing became so much oppressed, and her heart palpitated so violently, that she was taken into an adjacent house and profusely bled, from which she experienced immediate relief. Since that time she has had nearly twenty similar attacks; all of which were brought on by too much walking, and all of them were relieved by bleeding. The last attack was occasioned by her running up stairs very quickly, being at the same time greatly agitated; and upon this occasion the symptoms were also relieved by bloodletting.

Case of congestion caused by running.

CASE IV.—An eminent engraver who, though corpulent, was in good health, ran with all his speed to overtake a coach, and after getting into it he felt great exhaustion and a quickness in respiration, his heart at the same time beating violently. On leaving the coach and attempting to walk, he did so with great difficulty. The impulse of the heart with dyspnœa continued for several days, and were not relieved until after bloodletting, leeches, and antimonials had been employed.

Case of congestion from rowing a boat.

CASE V.—An officer, of great athletic powers, was engaged in a rowing match, which he won by unexampled exertion. On the following day, he applied to me on account of an embarrassment in his breathing, caused by the violent exertion, as well as by intense anxiety from the interest created by the match. There was no sensible change in the arterial pulse, but the heart's action was so tumultuous that its beatings were audible. Though the immediate symptoms were subdued by local depletion, the antiphlogistic treatment, and by antimony, yet, for a long time, the heart was very susceptible of excitement, whether arising from disturbance of the digestive apparatus or from moral causes; and, as is usually observed in organs which have been once injured, if from any accidental circumstance this patient's health was disturbed, that disturbance seldom failed to influence the action of the heart.

Extract from one of the patient's letters.

"For the last nine months, imagining that I had been perfectly well, never feeling any uneasiness in my heart, about a week ago I foolishly danced some reels, and that exertion brought back a return of my old complaint. I put on seven leeches the day I felt it, and applied mustard blisters twice, and have taken a good deal of opening medicine. I have not, however, got entirely rid of the uneasy sensation: sometimes it shows itself in a desire to draw a long breath; at other times I have a hot burning sensation around my heart, extending to the point of the shoulder, and a hissing, humming sort of noise in my left ear; and last night I have slept none the whole night, from a strong violent pulse, but not a very quick one."

All these symptoms were relieved by repeated bloodlettings and antimonials, and his health was permanently restored.

Case of congestion from rowing a boat.

CASE VI.—A student at Cambridge made a violent effort to win a rowing match, after which he suffered from great difficulty in breathing, a dry *cough*, and, finally, *hæmoptysis;* to relieve which symptoms a depletive system of treatment was followed. About two months afterwards, the affection of the chest being still unsubdued, he was pronounced to have "a cavern in his lung;" and when the same physician again saw him, four months afterwards, after a second lengthened stethoscopic examination, he pronounced that there was no cavern, and he was treated for pulmonary phthisis.

Sixteen months from the first attack, when he was suffering from a catarrhal affection, my attention was directed from a slight stain of blood in the mucous expectoration, to the condition of the circulation. I found the radial pulse small, and the heart's impulse much increased; he had palpitation, and more or less tenderness on pressing the cardiac region. Three leeches applied to the chest bled profusely; a third of a grain of tartarized antimony was given twice a day, and the leeches were twice repeated, at intervals of two days, with complete relief.

Case of congestion from carrying a heavy weight.

Case VII.—A chambermaid, who was daily in the habit of carrying coals up-stairs, became so breathless, as to be obliged to sit down and rest before she could again begin to ascend the stairs. After having suffered some weeks, she applied to me, complaining of very considerable difficulty in breathing, with a great increase in the impulse of the heart. By applying three leeches four times successively, and taking a dose of James's powder every night, she was relieved. Eight days afterwards she again complained of so great a difficulty in her breathing, that on walking a short distance, she was obliged to stop several times. On the following day the dyspnœa was very distressing, the impulse of the heart was much increased, but there was little change either in the quality or in the frequency of the arterial pulse. Four leeches were now applied to the region of the heart; they were repeated on the following day, and she took the third of a grain of tartarized antimony three times a day. The first leeches which were applied gave immediate relief, and she remained free from all dyspnœa, unless when she walked up a flight of stairs; this, however, soon abated, and the heart again beat with its usual impulse.

Case VIII.—Two years ago a lady advanced in life ran with unaccustomed speed, to overtake a carriage; when she got into it, she had a "gasping for breath," and great prostration of strength. On arriving at home, she was so faint that she was obliged to go to bed; after which she gradually recovered from the exhaustion, but her breathing remained embarrassed, and has continued so, along with a sense of tightness and oppression in the precordial region. She also complains of a dry, convulsive cough, a paroxysm of which comes on when going to bed, and another on getting up in the morning; and her breathing becomes much oppressed on going up-stairs, or on ascending a rising ground. The heart's impulse is strong, but the radial pulse is very feeble. All the symptoms were speedily subdued by a small number of leeches being applied to the precordial region, and the internal use of the tartarized antimony.

CASE IX.—A young lady ascended quickly the long flight of stairs of the "shaft" at Dover. When she arrived at the top of the cliff, she felt great embarrassment in breathing, accompanied with giddiness. After resting for a while she was able to walk home; but her breathing remained embarrassed, and was not tranquillized until after she had rested herself in the recumbent posture. She continued to complain of a difficulty in breathing, a great desire to relieve the chest from a sense of weight and oppression, with deep sighings. All which symptoms were relieved by local bloodletting and antimony.

Case of Congestion of the Heart from Singing.

The circulation becomes sometimes disturbed in persons who make great exertions in *singing*, or in playing wind-instruments.

A chorus-singer, of middle age, complained of a very distressing sense of tightness across the chest, limited and painful inspiration; the heart's impulse was greatly increased, but there was little alteration in the arterial pulse. He had a very troublesome dry *cough*, which came on in paroxysms, and which was often excited on making a very slight bodily exertion. The digestive organs were not materially deranged. Since his early life he had been accustomed to sing, and five years ago, after great fatigue from singing in St. Paul's cathedral, the sense of tightness and difficulty of breathing commenced, and he has never been quite well since.

Three leeches were now applied on the precordial region, which bled profusely; and a dose of James's powder, given at bed-time, produced a very decided relief of all the symptoms, especially the sense of constriction of the chest, the frequency and severity of the cough, and in the heart's impulse. After the antimonial powder had been taken four nights, the heart was tranquillized, and the respiration greatly facilitated. A dose of *camphor* and *ammonia* was afterwards given three times a day; and so manifest was the subsequent improvement, that, owing to the compound *steel* pill, taken three times a day, and a *belladonna* plaster applied to the chest, in fourteen days from the commencement of the treatment, he considered himself so much recovered as to discontinue the medicines.

Case of Congestion of the Heart from drinking Cold Water.

Case I.—A school-boy, when overheated at play, drank a tumbler of cold water. On returning home in half an hour, he began to complain of an uneasy feeling in the chest, and an embarrassment in breathing; after these symptoms continued for three days, he was bled at the arm, from which he derived immediate relief, and he completely recovered by the subsequent use of antimonials. Some time afterwards I saw this patient in perfect health, without having had the slightest return of the above disorder.

Case II.[1]—" A strong healthy man, aged about twenty-four, was mowing grass when the weather was warm. He drank water brought from a neighbouring well, sometimes cold, but generally after it was warmed by the heat of the weather; the quantity of cold water taken at one time never exceeded half a pint. One evening talking gave him considerable anxiety, accompanied with sighing; and he found it necessary, during conversation, to rest occasionally. These complaints remained the same until two days afterwards, and when talking, he was suddenly seized with the like difficulty in his breathing, and vision nearly departed. He was placed on the bed, and lost nearly all sense and voluntary motion. I saw him in a few minutes after, and found his extremities cold, a livid suffusion of the face and neck, and his pulse about 35, with weak action, which, after the exhibition of a little hartshorn, gained preternatural force, more especially that of the heart. White tongue, a little thirst, deep and frequent sighing, and a little pain at the epigastrium at each pulsation. I did not bleed at this time, but substituted the warm bath, and his pulse in a few minutes rose to 50 strokes in a minute, with less convulsive action. He fell into a warm sweat, and slept well. On the day following, he took saline draughts ; pulse 28, a little hard, still stronger about the heart and large vessels, with irregular intermissions ; the other symptoms as yesterday. Seven ounces of blood were taken from the arm ; it was sizy ; pulse during and after the operation, 33, but in the evening and night it beat only 14 strokes in a minute. The bath was again administered, but without any advantage ; he was costive, and had a dose of rhubarb, and took the saline draughts. Next day the pulse ranged between 14 and 28, till five P.M. At this time twelve ounces of blood were taken from the arm ; pulse rose after the operation from 28 to 37 strokes in a minute, and at nine in the evening to 60 and softer ; the other complaints much abated. On the following day, the pulse ranged between 30 and 50, but it was soft, his other complaints nearly gone. The day after, the pulse in the forenoon was 18, with anxiety, &c., but it increased in frequency, and in a few hours it stood at 54 ; a copious sweat then broke out, with an abatement of the anxiety, &c. He now became convalescent ; but his pulse was slower than natural for several days till it arose to about 70 ; he was soon after, and ever since, able to take exercise and labour without inconvenience."

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[1] Abstract of a case entitled, " Case of Disease with a remarkably retarded Pulse."—*American Medical Repository*, vol. i.

Case of Congestion of the Heart from eating a Hot Potato.

A young man, nine years ago, ate a mouthful of very *hot potato*, and immediately afterwards fell down ; he remained quite insensible for about ten minutes. Ever since that period he suffered pain in the cardiac region, palpitation, and *epistaxis.* His hands were usually very cold, and the veins congested, but sometimes the cold was so great as to make the extremities of the fingers pale and insensible. The radial pulse was scarcely perceptible, but the heart's impulse was moderately strong. The palpitation was not constant, but usually followed any quick movements of the body, or mental excitement. The digestive organs were perfectly healthy. From the *epistaxis*, occurring almost every day, I recommended the application of two leeches to the precordial region, and a quarter of a grain of tartarized antimony to be taken twice a day; the benefit derived was so decided, that he repeated the leeches four times. After a few days there was a manifest increase in the vigour of the pulse, and the impulse of the heart was diminished. He had no epistaxis after the first application of leeches; the capillary circulation in the extremities was much improved, and he was satisfied that a decided amendment had taken place. I now gave him the *compound steel pill*, which he took for some time with great benefit.

Case of Congestion of the Heart from Mental Excitement.

A lady suddenly lost one of her children, her grief was so intense that she fell into a deep melancholy, seldom spoke, and could not weep. By regulating the alimentary canal, giving her occasionally a large dose of calomel, and repeatedly abstracting blood locally from the head, she gradually resumed her wonted habits. I saw her twelve months afterwards, and my attention was then directed to an embarrassment in her breathing; the impulse of the heart was much increased, and there was a contracted pulse. It appeared that she had never recovered from the moral depression caused by her son's death. Alternate bleeding by leeches from the parietes of the chest and the feet, along with antimonials and neurotics, produced the most beneficial effects, and ultimately she completely recovered.

Cases of Congestion of the Heart from Disturbed Sleep.

Case I.—Mrs. —— complained of a sensation of giddiness, both when she was in the erect and horizontal postures, and of uneasiness in the chest, upon which she could not suffer the pressure even of the bed-clothes; she frequently felt the beatings of the heart, and had a frequent and troublesome dry cough. The radial pulse was frequent and tumultuous, all which symptoms had been present the last six days. Two leeches were now applied to the cardiac region, which bled moderately; she took a dose of James's powder at bed-time, and slept better the following night than she had done for two months previously, as during that period she had been in constant attendance on a sick daughter; her sleep was often interrupted.

Case II.—A nurse complained of a disagreeable sensation in the head, which afflicted her at all times of the day, but especially when she walked, and then it became so severe that she could not balance herself. On several occasions, she was compelled to take hold of some support to prevent her falling. She also had *tinnitus*, sometimes in one, and sometimes in both ears. The digestive organs were in a healthy condition; her pulse was natural in frequency, but rather small; the impulse of the heart was strong, and she complained of tenderness on pressing upon the cardiac region, causing a sob and difficulty in breathing. She had been for six months kept constantly watching a sick person, and seldom slept one hour at a time; sometimes being awaked four or five times in an hour, for several successive hours. She also complained of fearful apprehensions of death, when these sufferings were brought on; though, on other occasions, she felt no such terror, but rather a wish to die. By the repeated application of a few leeches on the chest, every second and third day, along with small doses of the tartarized antimony, the circulation became natural.

Case communicated by Mrs. P. B. Lucas.

Case III.—A young lady passed sleepless nights for several weeks; her sleep having been first disturbed by mental excitement. The radial pulse was small and soft; but the impulse of the heart was considerably increased. Five grains of James's powder, taken an hour before going to bed, and one drachm of the ammoniated tincture of valerian, an hour afterwards, produced calm and refreshing sleep.

Congestion of the Heart accompanied by Epistaxis.

A housemaid, after great bodily fatigue, was attacked with *epistaxis*, which returned twice a day for several successive days, but the quantity of blood lost was small. Some time afterwards, having suffered from an uneasy sensation in the abdomen, she vomited some blood. Though she never recovered her strength, there was no return of the epistaxis until three weeks before she was placed under my care. From that period the nose usually bled three times a day, the blood flowing in a continuous stream for about half an hour;—the quantity she estimated to be, not less than half a pint each time. She now became extremely feeble and emaciated, and quite incapable of any exertion; her breathing was greatly embarrassed, and she could not ascend a stair but by repeated efforts. She had a frequent dry cough, which generally came on in paroxysms. Her pulse was feeble and of natural frequency. The heart's impulse was vigorous, and she sometimes felt its palpitations. There was a tenderness over the whole precordial region, the catamenia had continued regular, and the digestive organs unimpaired. Not finding any benefit from a few doses of the tartarized antimony, two leeches were applied to the precordial region, and the blood flowed six hours, after which she was immediately relieved of the uneasy feelings and oppression in the cardiac region by a remarkable diminution in the frequency and severity of the cough and in the difficulty of breathing. During three successive days she repeated the antimonial pill, from which she did not appear to receive any benefit; on the fifth day from the commencement of the treatment, she took twice a day the *compound steel pills.* After taking six of them, she had no return of the epistaxis; the cough, the uneasy feelings in the chest, the beatings of the heart, and every symptom of her disorder was subdued. She continued to take the steel pills; when I saw her, six weeks from the commencement of the treatment, she had become much stronger, her general health restored, and had no return of her complaint.

Cases of Congestion of the Heart accompanied by Hæmoptysis.

Case I.—A painter, middle-aged, applied to me on account of a spitting of blood, frequent short cough, difficulty of breathing, with uneasy feelings in his chest. The radial pulse was small, and not increased in frequency, but there was a considerable increase in the impulse of the heart. Three *leeches* were applied to the precordial region, and repeated in two days. The *tartarized antimony*, combined with calomel, was at the same time administered; after this treatment had been continued for a week, the symptoms were all subdued, except the cough. He was then ordered squills, combined with ipecacuanha and the common mercurial pill: this treatment being continued during ten days, he considered himself convalescent, and used no further remedies.

CASE II.—A young lady applied to me on account of a teazing cough, accompanied occasionally with a spitting of a small quantity of blood, from which she had suffered several years, and had spent six seasons abroad; several physicians whom she had consulted treated her for pulmonary phthisis. She had a small thready but not a frequent pulse; and the impulse of the heart was considerably increased. Her breathing was slightly embarrassed, and she had occasionally uneasy feelings in the chest.

By the application of a couple of leeches on the cardiac region, and repeating them in a few days, at the same time taking a dose of James's powder every night, the cough and hæmoptysis were subdued; after which her general health and strength rapidly improved by the use of the compound steel pill. When I heard of her some time afterwards, her complaint had not returned; she had married, and was the mother of a family.

Congestion of the Heart accompanied by Sneezing.

Case communicated by Mrs. Macintosh.

"A young woman had a violent fit of *sneezing*, which had continued without interruption for two hours; but, immediately after twenty ounces of blood had been abstracted from the arm, the sneezing was completely arrested. She had been subject to hysteria, and occasional palpitation."

Case of Congestion of the Heart succeeding Hooping-Cough.

A youth applied to me on account of a cough, with which he had been afflicted, since an attack of hooping-cough five months previously. The cough was dry, came on in paroxysms, and was troublesome during the night, and on getting out of bed. The heart's impulse was vigorous, and the radial pulse small. Two leeches were applied to the precordial region in the evening; the bleeding did not cease until the following morning; a dose of James's powder was taken at bed-time. The day after the leeches were applied there was scarcely a vestige of cough remaining; and after taking James's powder for three nights, I ordered him the compound steel pill, which he took twice a day for ten days. Since then he has had no return of the cough, and his general health is completely restored.

Case of Congestion of the Heart accompanied by Hiccup.

A gentleman, fifty-five years of age, had a severe apoplectic fit, accompanied with loss of power of the left side, and also of the intellectual powers. The symptoms were subdued by small depletions and evacuants; six months afterwards, during his convalescence, he was seized with an incessant hiccup: after having made use, unsuccessfully, of a variety of medicines, my attention was directed to the heart, the beating of which was tumultuous. I ordered him one grain of crude *opium* every two hours, and applied a *belladonna* plaster to the precordial region; after taking two of the pills the hiccup did not return.

Case of Congestion of the Heart accompanied by Muscæ Volitantes.

Mrs. ——, in the forty-fifth year of her age, applied to me on account of *muscæ*, which appeared before the left eye, along with occasional " swimming in the head." She was easily excited and alarmed. She complained of uneasy feelings about the upper part of the chest and root of the neck; a feeling of tightness accompanied by pain in the cardiac region, and a difficulty of expanding the chest; a dry cough came on in the morning when getting out of bed, which was sometimes very violent, and during the day more or less troublesome. Her face was flushed and puffy, and she suffered from cold legs and feet. The slightest movements of the body, or any mental excitement, caused palpitations; from which she also suffered when in bed. The radial pulse was small and oppressed. The impulse of the heart was greatly increased, and pressure on the cardiac region gave pain. The digestive and uterine systems were healthy. The uneasy feelings in the chest were at least of eight years' duration, and twelve months ago the false images first appeared before the left eye.

I recommended two leeches to be applied to the cardiac region, and one-third of a grain of the *tartarized antimony* with rhubarb and soap to be taken night and morning. The leeches bled profusely, and one continued to bleed *twenty-six hours*. Most decided relief was obtained from the bleeding; the antimonial pills caused no sickness, but operated frequently and copiously on the bowels. She afterwards took a dose of *ammonia* and *camphor* two or three times a day; on the seventh day the cardiac and radial pulse became quite natural; the uneasy feelings in the chest, the tenderness to the touch, and the uneasy feelings in the neck, were subdued; the flushing of the countenance disappeared. She now discontinued the antimony, and took the *compound steel pill*, and a mixture of *camphor*, *rhubarb*, and *ammonia;* after continuing these medicines about three weeks, she returned home perfectly well in all respects except "the false images" which appeared before her left eye,—these not having undergone any change.

Cases of Congestion of the Heart accompanied by Cough.

Case I.—A lady of middle age complained of a *cough*, which came on at all hours in violent paroxysms, preventing sleep, and accompanied by an embarrassment in breathing, great difficulty in ascending a stair, and an increase in the heart's impulse. The digestive organs were natural. She found no relief from an antiphlogistic treatment. The cough came on four months before she consulted me, immediately after walking quickly on a cold day. Previously she had occasionally suffered from palpitations. I prescribed one grain of the *sulphate of zinc*, with the *compound galbanum pill*, to be taken twice a day. The first pill produced a manifest abatement of the cough: on the second day it was still more diminished, both in severity and frequency; and on the fourth day it was quite subdued; but she continued the pills altogether for six days. A corresponding amendment took place in her breathing, and the impulse of the heart was reduced to its natural standard.

Case II.—A lady, twenty-eight years of age, complained of a *cough* so severe, that for many nights she had been obliged to sit up in bed. The impulse of the heart was so much increased, that she frequently felt the heart palpitate, especially on making the slightest bodily or mental exertion. By the application of a couple of leeches upon the chest, and a dose of James's powder at bed-time, and by twice repeating the leeches, at intervals of three days, along with the antimonial, all the symptoms were subdued, and the respiratory and circulating organs were restored to a healthy condition.

Congestion of the Heart, accompanied by Sickness and Vomiting.

Case I.—A governess, in the twenty-fifth year of her age, had been suffering, for upwards of twelve months, from a cough, which was accompanied by occasional sickness and vomiting, and had been treated with a variety of expectorants. The radial pulse was small, and of natural frequency; the heart's impulse was increased in strength; there was tenderness in the cardiac region on gentle pressure; a dry cough came on in severe paroxysms, and sometimes ended in the vomiting of a tough transparent mucus; the digestive organs were deranged and the menses were irregular. By the application of three leeches to the precordial region, an emetic, and the tartarized *antimony* continued for a few days in small doses, all the symptoms were completely subdued, and she was soon restored to perfect health.

Case II.—A lawyer's clerk, soon after getting out of bed, felt sick, but did not vomit. He experienced sickness every day during a month, which came on at all hours, particularly after breakfast. The arterial pulse was small and irregular; the impulse of the heart strong and tumultuous, with irregular pauses; but the digestive apparatus was healthy. After taking one-fourth of a grain of tartarized antimony morning and night for six days, the symptoms were so much subdued that he required no other medicine.

Case of Congestion of the Heart, accompanied with a loss of power in the fingers of one hand.

A pale young lady of a delicate frame, applied to me on account of an affection of the right hand, with which she had been afflicted about eighteen months. All the fingers and the whole hand, as far as the wrist, were quite motionless and slightly œdematous, but the sense of touch was unimpaired. During this period, the motion of the fingers had several times returned and was again lost. In these different attacks, the longest period, during which motion was lost, was about fourteen weeks. She used a variety both of local and general remedies, without the least benefit.

As there was a considerable increase in the impulse of the heart, I thought it possible that the affection of the hand might arise from the heart being congested, causing some disturbance in the circulation of the *motor* column of the spinal cord. Three leeches applied to the cardiac region bled profusely; the motion of the hand and fingers was in a few days quite restored.

During five years afterwards she had repeated attacks, commencing with an uneasy sensation in the muscles of the fore-arm; a short time after which, the hand and fingers lost their power of motion. On none of these occasions did the movements ever return, until leeches were applied to the chest; these never failed to produce the desired effect in three or four hours. The average number of leeches, which she applied, were three on each attack; she kept a regular account of the number, which exceeded twelve hundred in five years.

During the last year, she applied leeches only three times; and although the attacks were frequent, they all yielded to dry cupping on the cardiac region. When I last saw her she was in good health, except being occasionally troubled with slight palpitation.

Case of Congestion of the Heart, accompanied with Irregular Menstruation.

A lady, fifteen years of age, had been afflicted nearly two years with difficulty in breathing on the least bodily exertion; and during that period had eight paroxysms, during which she was seized with dyspnœa and violent palpitation. For the relief of all these attacks she was bled at the arm, confined some days to bed, and attention paid to the digestive organs. On the return of an attack, she applied to me, when I found the radial pulse frequent, but easily compressed, and she had violent palpitation of the heart. One leech was applied to the foot, and the pediluvium employed afterwards. In three hours, she experienced great relief in the chest, and perspired profusely; a circumstance unusual with her. She took afterwards repeated doses of James's powder; the bowels were easily regulated; she speedily recovered, and gradually passed into a state of uninterrupted health.

Case of Congestion of the Heart from Railway Travelling.

A stockbroker, who had been in the habit of travelling daily by the railroad from Brighton to London, and from London to Brighton, began to feel uneasy feelings in the head, which compelled him to relinquish that mode of travelling. By the repeated application of a few leeches to the region of the heart, along with antimonials, the impulse of the heart, which had been much increased, now became tranquil; the giddiness, the constant sounds in his ears, and the occasional ocular spectra, were permanently subdued.

Congestion of the Heart from causes not manifest.

Though a congested state of the heart will seldom be met with, where the origin of the disease cannot be satisfactorily ascertained, yet I have frequently seen cases, in which no distinct cause could be assigned, but where the assemblage of symptoms, and the successful result of the treatment explained the true nature of the malady. This is no more surprising than what is observed in other organs; derangements in their functions frequently taking place without our being able to assign them to any particular cause.

Case communicated by Mr. Mackilpin.

CASE I.—" A girl, seven years of age, of spare habit of body, had been in ill health about nine months, during which period she was several times seized in the night with the most violent alarm, springing from her bed, screaming, and running about the house. She had been treated for an affection of the stomach by two physicians, but without benefit. I found her labouring under violent continued action of the heart; the spaces between the intercostal muscles were protruded at every contraction of the ventricle; the radial pulse was proportionably strong; her tongue was slightly furred, and the bowels were sluggish. The treatment now adopted consisted in the application of two leeches to one foot, every fourth day; mild aperients, and light diet. This plan was pursued for three weeks, when the patient was so much improved, that the leeches were discontinued, and small doses of sulphate of iron, with infusion of gentian, were given twice a day; a mild alterative and aperient at night. At the end of a month the action of the heart was reduced to its natural state, and the patient was restored to health, and remained free from any affection of the heart when I saw her, after a lapse of more than three years."

Case II.—A footman complained of a sensation of tightness in the chest, sometimes amounting to pain, and there was tenderness on pressing upon the cardiac region. He could not inspire fully without uneasiness, and on going up stairs found difficulty in breathing. The radial pulse was rather small, and of natural frequency; but the impulse of the heart was greatly increased. He suffered these uneasy feelings about three months; he had no cough, and the digestive organs were healthy. He could assign no cause for his illness. He took the third of a grain of the tartarized antimony twice a day for three days, with only slight relief. Two leeches were now applied to the cardiac region, which bled three hours freely; on the following day, all the uneasy feelings in the chest were gone, the heart's impulse subdued, and the radial pulse had become soft. He continued the antimonial pills, and took altogether sixteen of them; at the end of which period he appeared to be, in all respects, in perfect health.

Case III.—The clerk of a solicitor complained of a severe and unceasing pain in the precordial region, which was much increased by slight pressure, and was accompanied by an uneasy sensation in the head, limited to the occipital region; with great debility, coldness of the legs and feet, imperfect sleep often suddenly interrupted. The impulse of the heart was increased; the radial pulse was small, compressed, and of its natural frequency. All these symptoms had been of only a few days' duration, and had come on without any evident cause, unless from having been exposed to a good deal of mental fatigue. Two leeches were applied to the precordial region, and repeated four times at the interval of one day between each application; during the same period he took eight grains of the tartarized antimony, divided into twenty-four doses. The effect of these remedies was to relieve the local pain, to diminish the heart's impulse, and to render the arterial pulse softer. He still, however, complained of palpitation and mental irritability, which camphor and ammonia failed to relieve, but which completely yielded to the exhibition of two drops of the dilute *hydrocyanic acid* twice a day. For some time afterwards these symptoms occasionally recurred, but on every occasion they were subdued by the acid.

CHAPTER XL.

DISEASES OF THE HEART FROM A DIMINUTION IN THE QUANTITY OF ITS BLOOD.

Effects of the loss of blood on the heart; syncope; different causes of syncope; treatment of syncope; anæmia, its symptoms and treatment.

"The heart acts best," observes Hunter, "with a moderate quantity of blood." If it be congested, then follow all those phenomena which have been so fully described; but if the quantity be diminished below the natural standard, then symptoms of a very different character are developed.

The effects of a diminution of blood in the heart, we have opportunities of observing, where a large quantity has been abstracted from the body artificially, or in consequence of a severe hæmorrhage, such as often occurs during parturition. In either of these cases the cardiac and radial pulse at first become quickened, and gradually lose their vigour, until they can no longer be perceived to beat, the intellectual powers fade, and *syncope* supervenes.

Syncope, its phenomena.

If the depletion has not been such as to destroy life, the fainting state is followed by a series of phenomena; all which are the effects of those instinctive acts of the economy, employed by the *vis conservatrix*, in order to increase the quantity of blood within the heart; phenomena which, by the influence of the musculo-cardiac function, invigorate the circulation. "Hence, fits of syncope are frequently attended with, or terminate in *vomiting*, sometimes in *convulsions*, or in an *epileptic* fit." Cullen.

It has been observed, that the fainting state, caused by a spontaneous hæmorrhage, becomes one of the means which nature adopts in order to arrest the bleeding. Not only does the languid state of the circulation, produced by the loss of blood, favour its coagulation, and the formation of a clot on the mouths of the bleeding vessels; but experiments on living animals show that the more frequently they are bled, the more speedily does the remaining blood coagulate; so that the fainting state caused by the loss of blood, which creates so much alarm to the bystander, is a powerful means of stopping the bleeding.

It has been likewise mentioned, that syncope is one of those acts which are resorted to by the economy to relieve certain disturbances of the heart; the fainting state causing such a diminution in its vigour, and consequently in the impetus of the blood, that the circulation recovers its natural state.

There is another cause of fainting occasionally observed, which does not arise from the loss of blood, but from its unequal distribution to different organs. When, by the sudden evacuation of the water in *ascites*, the blood is allowed to flow into the vessels from which all the pressure caused by the distention of the water is removed, the quantity of blood in the heart and large vessels is proportionally diminished, and thus syncope ensues.

Case narrated by Lefevre.

A lady, who had immense varicose veins in both legs, fainted whenever she was in the erect posture, the veins becoming reservoirs of a large quantity of blood; so that the balance of the circulation was destroyed, and the cerebro-spinal system deprived of its due quantity of the vital element.

Syncope may also arise from a diminution in the vigour of the heart, by the influence of the nervous system. Of this condition of the circulation we daily see examples; it is sufficient to refer here to observations already made on the influence of the depressing passions in diminishing the action of the heart.

The syncope that is caused by an obstructed circulation, from a change in the structure of the heart, is of a far more serious character, than that caused either by a profuse depletion or by mental emotion; for, if a fit of syncope takes place when the heart's tissues are diseased, such interruptions to the transit of the blood through the heart's cavities must always be considered as indicating some important change in the heart's apparatus. Hence a fainting state, and even complete syncope, is by no means an unfrequent symptom in many organic diseases of the central organ. When this condition continues beyond a certain time, life is extinguished: so that syncope is frequently the immediate cause of death in those who have long been suffering from a diseased heart.

Treatment.—In syncope from the loss of blood, the vigour of the heart may be restored by the administration of those remedial means which stimulate the nerves of the heart; and likewise by those which increase the quantity of its blood.

The first of these indications is fulfilled by stimulating the gustatory, the olfactory, and the cutaneous nerves; with all which the heart has an intimate relation. The second indication is accomplished by the *horizontal posture*, by artificial breathing, and by applying a ligature, or a tourniquet, on one or more of the extremities, in such a manner, that, by stemming the vital stream which supplies them, more blood remains in the heart and brain.

The good effects of *vomiting* ought likewise to be kept in mind—an act which the economy employs to restore the circulation in syncope; for the same purpose artificial *respiration* may be beneficially had recourse to.

Anæmia.

Besides syncope from an excessive loss of blood, other changes are produced in the condition of the heart. Palpitation comes on more or less violently, and respiration is accelerated; both which symptoms are greatly increased by the least bodily exertion or mental emotion. The cutaneous surface becomes pale, there is great general debility, and ultimately anasarca.

These changes in the sanguiferous system are not only the effects of a diminished quantity of the mass of blood, but are likewise the effects of changes in its qualities. The shock, which the economy receives after a profuse hæmorrhage, renders both the processes of incretion and of excretion to be imperfectly performed, and hence changes are produced in the constituents of the vital fluid.

In the treatment of such cases, all those remedial means should be employed which regulate and improve the incrementitious processes. Thus *stomachics* may be advantageously had recourse to, in order to aid digestion; a salubrious atmosphere will assist respiration; the condition of the cutaneous surface will be improved by *dermatics*, and the blood itself by the administration of *hæmatics*.

CHAPTER XLI.

DISEASES OF THE HEART FROM CHANGES IN THE QUALITIES OF THE BLOOD.

The phenomena and causes of changes in the qualities of the blood; the numerous changes in the blood disturb the heart; the humoral pathology, founded on these changes of the blood; influence of the digestive, respiratory, and cutaneous systems in changing the blood; other causes by which the blood is vitiated; how minute portions of extraneous matters change the blood, illustrated in inorganic fluids; rapidity of these changes; the precise nature of the changes of the blood little understood; the limited aid which has been derived from chemical science; importance of chemistry and physiology combined; the symptoms, diagnosis, prognosis, and treatment of the functional diseases of the heart, caused by changes in the blood's qualities.

General observations.

We come next to consider the functional disorders of the heart, which are caused by changes in the qualities of the blood; for however frequent may be those functional diseases which arise from changes in the blood's *quantities*, yet far more numerous are those which are produced by changes in the qualities of that vital fluid.

The numerous changes in the blood which disturb the heart.

When we contemplate the vast number of changes which the blood must necessarily undergo, from differences in the qualities of the elements with which it is supplied at different times, and from differences in the manner in which the incrementitious and the excrementitious processes are performed in the vital laboratory, we may anticipate that disturbances in the functions of the heart must be constantly taking place. Even in health, the fibrine, the albumen, the red globules, and the serum of the vital fluid, are never, for any length of time, in the same proportions.

Can we contemplate the functional disorders of the heart, that are caused by changes in the blood, without being impressed with the disturbances which these changes must create in other organs? Thus, in like manner, as it has been shown that there is a general law by which some medicinal bodies act upon certain organs, or systems of organs, so it is as regards the presence of any noxious elements in the blood, each of these creates a disease in a particular organ. The liver is affected in some fevers, the spleen in others, and the mucous membrane of the intestinal canal suffers in cholera.

"A morbid state of the blood is strikingly exemplified in those diseases where only a portion of a tissue is changed, and where the corresponding portion of the same tissue of the opposite side of the body is similarly changed: a similar eruption on both hands, or on both legs."

Paget's *Pathology*.

We must not, therefore, view the disorders of the heart, which are produced by changes in the blood in an isolated manner; as it is legitimate to infer, that not only particular organs are deranged in these functional ailments, but that the presence of the vitiated fluid will influence, more or less, the whole sanguiferous system.

Origin of the humoral pathology.

It was upon these changes in the qualities of the blood that the school of the "Humoral Pathologists" was founded: however erroneous may have been some of the conjectures, and however hypothetical some of the doctrines of their disciples, regarding the nature of these changes, there cannot be a doubt but that essential alterations in the qualities of the blood do take place in many diseases; and also that the blood exercises a vast influence, not only on the functions of the heart, but also upon the whole animal fabric; affording incontrovertible evidence of the truth, that changes in the quality of the blood, or "errors in the fluids," are the proximate causes of diseases.

Differences in arterial and venous blood.

I have formerly mentioned, that much ambiguity has arisen in physiological and in pathological writings from the term "blood" being used in a generic sense, and that the differences in the arterial and venous blood have been greatly disregarded. This is, however, to be regretted, as there are, doubtless, essential differences in the two bloods, though chemical science has not yet determined them. It is the differences in the arterial blood which are the cause of many diseases; whereas, the venous blood, having passed through the various secreting organs, must essentially differ from the arterial blood in its elements; the vital processes, which each organ performs, being perfectly distinct.

It is likewise to be taken into consideration, that almost all the experiments on the human blood have been made on blood taken from veins in the *arm;* thus rendering it impossible to draw any general conclusions on the nature even of the venous blood; and its diseases do not arise, like those from the arterial blood, from changes in its qualities, but from variations in its quantity in particular organs. The opportunities of analysing the *arterial* blood have not yet been taken advantage of; and, though the menstrual flux has been carefully examined, there has been no minute analysis made either of the hæmorrhoidal flux, or of the blood of epistaxis, or hæmoptysis.

Brand.

Causes which change the blood.

So numerous are the changes produced in the blood, even when the body may be considered in a state of health, that we are led to anticipate that, by the varied disturbances of the digestive, the respiratory, and the cutaneous systems, numerous changes will take place in the qualities of the vital fluid, which cannot fail to produce corresponding derangements in the functions of the heart; although the nature of these changes has not been defined, yet we cannot doubt of their existence.

The nature of the processes performed by the various organs, from the time when the incretions enter the blood until the excretions are separated from it, not being understood, we could not expect that the elements, qualitative and quantitative, with which the blood is furnished, could be accurately ascertained; nor could we, without a previous knowledge of the nature of these varied constituents of the blood, refer changes of the heart's functions to corresponding changes in the blood's qualities.

In a few instances this has certainly been accomplished. One of the most remarkable changes of the blood, accompanied with a great increase in the heart's action, is in *chlorosis;* in which disease there is a diminution in the proportion of the *red globules.* In other diseases, where the heart's action is deranged, such as in *inflammations*, especially the rheumatic, there is an increase in the proportion of *fibrine.* In the Asiatic cholera there is a diminution in the proportion of *serum;* whereas in *scurvy*, and after violent muscular exertions, the blood loses its *coagulating* power: a similar change takes place from *mental emotions*, and from the influence of *electricity*.

Influence of the digestive functions on the blood.

The *digestive* apparatus, whether from a disordered condition of its own functions, or from receiving improper food, will eliminate chyle of an unhealthy character; which, after being mixed with the blood, must not only taint the sanguiferous system, but influence the functions of particular organs.

Thus, when the salivary glands, the pancreas, or the liver, do not duly perform their functions, the changes in the different fluids which they secrete must alter the quality of the chyle, and consequently produce changes in the blood. Differences in the quantity and quality of the food will likewise produce important changes in the incretions. On these differences is founded the whole system of *dietetics*. Living upon *salted* meats alone, or upon *sugar*, or *albumen*, materially injures the health by the changes they produce in the blood. The qualities of the blood are variously changed, according to the kind of food on which we live. The inhabitants of the torrid zone live chiefly on fruits and vegetables; whilst those of the Arctic regions subsist chiefly on flesh and the fat of animals.[1]

The effects of derangements of the *excrementitious* processes of the alimentary canal, by contaminating the blood and disturbing the functions of the heart, are equally as striking as those of incretion; for when the excretions are not separated from the blood, the vital fluid remains permanently vitiated, disturbing not only the functions of the heart, but also those of the whole sanguiferous system. Of this we have abundant proofs, when excrementitious matters are detained in the alimentary canal.

Effects of the re-absorption of excreted fluids.

But when excretions have been separated from the blood, and afterwards *re-absorbed* and mixed with the vital fluid, remarkable disturbances take place in the sanguiferous system. Thus, in long retentions of *urine*, during which its secretion is not only diminished, but urine contained within the bladder is re-absorbed into and mixed with the blood, the functions of the heart become deranged, and great excitement is created throughout the whole system. Those who die from retention of urine, perish not from disease of the bladder, but from the poisonous effects of the urine which is re-absorbed and mixed with the vital element.

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[1] "If we were exposed to the same degree of cold as the Samoyedes, we should be able with ease to consume ten pounds of fish or flesh, and perhaps also a dozen of tallow candles, daily."—LIEBIG'S *An. Chem.*

"I would average the Esquimaux ration in a season of plenty—it is, of course, a mere estimate, but I believe a perfectly fair one—at *eight* or *ten* pounds a day, with soup and water to the extent of half a gallon."—KANE'S *Arctic Explorations.*

The absorption of *purulent* matter in an abscess is not less injurious; and when the blood becomes contaminated by it, the frequency of the heart's action is increased, and the patient becomes *hectic*. The same phenomena are also observed in jaundice, where the *bile*, after it has been secreted, is re-absorbed into and mixed with the general mass of blood; and also, when the *milk* has not been withdrawn from the mamma, but is re-absorbed and mixed with the blood.

Influence of the respiratory organs on the blood.

The organs of *respiration*, either from an imperfection in their function, or from noxious ingredients in the air which are inspired, cause changes in the qualities of the blood, which will not only derange the functions of the heart, but produce injurious effects on the whole animal economy.

Changes in the pulmonary absorption on the blood.

As the qualities of the *chyle* are modified by differences in the mode in which the digestive function is performed, we may anticipate that the ingredients in the air, which are absorbed by the lungs, will not always be the same, but will differ, according to the condition of the pulmonary apparatus; and that the lungs will separate from the air different elements, just as the digestive canal separates different ingredients from the food. And, as differences in the qualities of the food cause changes in the chyle, in like manner differences in the atmospheric air will create corresponding changes in the pulmonary absorption.

Their nature not explained.

These various changes in the blood, which must necessarily take place in the lungs, both in health and disease, have hitherto evaded chemical research. That they do not depend upon differences in the proportion of oxygen and nitrogen contained in the air, is quite certain, as this never varies in any place or in any climate. The arterial blood, however, has not always been found to contain the same proportion of these elements.

Besides, there are constituents in the atmosphere, the presence of which we only know by their noxious influence on the animal economy. This influence must be the result of changes which they produce in the blood. The paroxysms of asthma, the rheumatic pains, that afflict many persons upon every change in the air, and the history of epidemic diseases, are all striking examples of atmospheric agencies.

Changes in the pulmonary exhalation on the blood,

The functions of the heart are likewise modified by changes in the *excrementitious* processes, which are performed by the respiratory apparatus; and when the pulmonary excretions are not duly separated, the blood becomes tainted, creating disturbances throughout the sanguiferous system.

and in the cutaneous system.

The *cutaneous* system contributes also an important share in modifying the qualities of the blood, both from the matters which it absorbs, and from those which it separates and discharges from the system. When either of these functions of the skin is interrupted, or not duly performed, the blood becomes more or less vitiated, and corresponding derangements take place in the action of the heart.

Other causes of changes in the blood;

Besides the numerous changes in the blood, arising from derangements of the digestive, respiratory, and cutaneous systems, there are also other causes which contaminate the vital fluid.

from organic diseases;

Whenever the function of any organ of the body is deranged, changes almost always take place in the qualities of the blood: the pale, squalid appearance of the cutaneous surface, as well as the disturbed heart, are most striking characters of some organ being diseased by vitiated blood.

from organic diseases of the heart;

and from malformation.

Changes in the blood's qualities also accompany many diseases of the tissues of the heart, as well as disorders of its functions; and there are serious disturbances in the action of the heart in many of those cases of *malformation*, wherein the venous and arterial bloods are mixed.

Besides all these changes, which disturb the heart's functions, the blood is also contaminated in specific diseases, as in *scrofula*, *syphilis*, and in the *exanthemata*. In *anœmia* the blood is also changed by imperfections in some of the incrementitious processes. When the lungs, the digestive organs, or the skin, are diseased, the imperfect manner in which their functions are performed produces changes in the blood.

Blood changed by minute portions of matter.

Numerous as these manifest causes are, there are none of them, however inconsiderable they may appear, that will not exercise a more or less important influence on the functions of the heart.

That inconceivably small molecules do exist in the air, we have evidence by our sense of smell.

Layard's *Nineveh.*

"Standing one day," Mr. Layard states, "on a distant part of the mound on which the *monolith* was found, I smelt the sweet smell of burning cedar. The Arab workmen had dug out a beam, and made a fire of it to warm themselves. The inscription spoke of cedars brought from the forest of Lebanon to build the palace of the great king . . . who had erected it. After three thousand years, the precious wood had retained its original fragrance."

The mere contact, on a small portion of the cutaneous surface,—the introduction, under the skin, of a minute portion of a specific virus,—one inspiration of a contagious atmosphere, are all proofs of the minuteness in the quantity of certain elements which is required to contaminate the whole mass of the blood.

Thus illustrated.

Liebig.

The effect of a small quantity of certain substances, such as of *yeast*, on comparatively large quantities of matter, transferring it into new compounds, shows how minute a portion of certain substances introduced by the lungs, or absorbed by the alimentary canal, or by the skin, may cause a complete transformation of the whole mass of the vital fluid. In the same manner as the slightest chemical action, the mere contact of atmospheric air excites a new arrangement of all the atoms of dead animal matter whilst undergoing decomposition, it is legitimate to infer that changes in the blood may be effected by equally slight causes.

"A little leaven leaveneth the whole lump."[1]

Rapidity of these changes.

We may here notice the remarkable *rapidity* with which changes are produced in the blood, so manifest in the development of many diseases. The short space of time that is required to contaminate the whole mass by the inhalation of *miasmata*, and by the inoculation of some specific diseases, has in this respect a strict analogy to the process of fermentation, or to the sudden decomposition of organic substances after death.

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[1] "If you throw a little melted grease, or a small quantity of animal oil, upon the surface of a working liquor, when in the highest foam, the curved intestine motion sinks to flatness in an instant; nor can it be recovered into a new head by any art known to our brewers or distillers."

"Therefore, perhaps, the reason why clarified new fresh-butter is a specific for the *bloody flux:* two spoonfuls twice or thrice within the day.

"At the siege of Londonderry, the dysentery was stopt by the use of *tallow* found there, and used with the oatmeal for food."—DODSLEY'S *Annual Register*, 1761.

Nature of the blood's ingredients yet undetermined.

Further, when we consider how exceedingly minute the portion of any noxious matter in the atmosphere may be by which the whole mass of blood can be contaminated, it is not to be expected that such minute ingredients could be, each, separated from the blood. The chemical philosopher has not as yet been able to obtain from the blood these elements, and ascertain their nature, nor has he succeeded in separating the molecules of an odorous substance, such as *musk*, which are diffused through a large bulk of air; though of their presence we have indubitable testimony from the sense of smell.

Effects of medicinal substances.

Equally remarkable are the effects of a minute quantity of some *medicinal substances* on the blood; quantities so minute that they have never been detected by chemical analysis.

These remarkable phenomena have been assiduously promulgated by the "charlatan;" and upon them has been based the "Homœopathic" system.

Symptoms and Diagnosis.

Though we may not be able to discriminate the symptoms of those functional disturbances of the heart which are caused by changes in the blood's qualities, it is, however, of primary importance to distinguish them from those which are the effects of an increase in its quantity, or from morbid changes in the heart's tissues. That such discrimination is no easy task, there cannot be a more convincing proof, than the numerous errors in *diagnosis* which are daily committed, and the dubious opinions so frequently given by intelligent observers.

It often happens that the heart's functions are disordered by the influence of the nervous system; but there is much reason to believe that the same nervous influence is often accompanied, and, in many instances, caused by changes in the qualities of the blood; so that, besides those medicines which tranquillize the cerebro-spinal system, it is often necessary, in the treatment of such affections, likewise to administer those which change the qualities of the blood.

The physiological symptoms.

The *physiological symptoms* of the disturbances of the heart caused by changes in the qualities of the blood, are such as may be anticipated would arise from all the different organs and systems of the economy being supplied with a vitiated blood.

An unhealthy blood has a powerful effect on the *cerebro-spinal* system: the intellectual powers become excited, the mind irritable, and sleep imperfect or interrupted; and when an excretion, such as the bile, has been re-absorbed and mixed with the blood, the mind becomes sluggish and inert, accompanied by general debility and emaciation.

The functions of the *respiratory organs* will depend on the changes in the blood, which are caused by errors in the incrementitious and excrementitious processes of the digestive and cutaneous systems; as in either case the lungs will be required to assist in performing the functions of those organs which are imperfect.

The condition of the *digestive organs* will greatly contribute to assist a correct *diagnosis* to be formed of the nature of the disorders of the heart's functions; and, as I formerly observed, that usually those who have a primary organic affection of the heart have seldom the digestive organs much deranged; but when the digestive organs are primarily disordered, along with a derangement in the heart's functions, we may then suspect that the affection of the heart is sympathetic.

The *cutaneous system*, from its connexion with the heart, must necessarily participate in the diseases of the heart. Accordingly, we find that in the heart's functional diseases caused by changes in the blood, the cutaneous surface exudes a vitiated perspiration; becomes pale and bloodless; or, as in the *morbus ceruleus*, the skin acquires a deep crimson hue.

The anatomical symptoms.

The *anatomical symptoms* of the disorders of the heart's functions from changes in the blood, demand an attentive scrutiny; more especially as these are apt to be mistaken for the symptoms of some organic mischief.

Changes in the impulse.

In most cases the *impulse*, as well as the frequency, of the heart's contractions are increased, and sometimes the force is so much augmented as to cause the pulsations to be perceptible to the patient.

To express a beating of the heart sufficiently intense to be felt by the patient, the term *palpitation* has usually been employed; and great confusion has arisen in systems of nosology, from this *symptom* having been adopted as a generic term, comprising under it many different disorders of the heart; just as *headache* has been used to denote not only a symptom, but a *genus* of disease.

Palpitation is indeed so common a symptom, that few affected with a disordered heart have not, at one time or other, suffered from it,—an increase in the heart's impulse being a frequent indication both of organic and functional diseases.

Changes in the sounds.

The disturbances that take place in the heart's functions from changes in the qualities of the blood, are, in many instances, accompanied by changes in the *sounds*. This may be anticipated, when we recollect, that as the sounds depend upon the currents of the blood passing through the heart's cavities, any change in the functions of the heart, which alters the currents, must necessarily change the sounds. On this principle I would account for the "bellows sound," so often observed in *anœmia*, caused from excessive hæmorrhage, and also in *chlorosis*. But the "bellows sound," in functional disorders of the heart, must be taken as a diagnostic sign with great caution, as it is met with in many very different morbid conditions of the heart, so that no certain conclusion can be drawn from its presence. In forming a diagnosis, special care must be taken, in each case, to view the whole assemblage of the symptoms, physiological as well as anatomical; by which alone we can be enabled to refer the morbid sound to a functional or to an organic disease.

"The different signs furnished by auscultation in order to distinguish an organic affection of the heart, may be manifested when no such affection exists. On the other hand, it is no less certain that the affection may be very grave, and nevertheless it cannot be revealed by auscultation." Andral.

The *permanency* of the symptoms is an important diagnostic character; for in the disturbances of the heart's functions, where there is a change in the qualities of blood, there is necessarily an unceasing interruption of the circulation; whereas, in symptomatic affections, the symptoms vary exceedingly in their intensity and duration, and even cease altogether for a certain time, assuming a paroxysmal character.

Prognosis.—In no diseases is a correct prognosis more desirable than in those of the heart; for whenever the attention of a patient has been directed to the condition of this organ he becomes extremely anxious to know, not only the nature of the disorder, but the probable results, whether it be organic or merely functional: I have already pointed out the line of conduct which the practitioner should pursue in the moral treatment of the sick.

The functional diseases which we have now been considering, however severe and alarming they may sometimes become, are yet seldom of a dangerous character; many people pass through a long life suffering from such affections, and ultimately perish from some malady unconnected with the organs of circulation.

Treatment.

So numerous being the changes to which the blood is liable, how important it must be in the treatment of those disturbances of the heart depending upon such changes, to be able to detect what are the organs or system of organs which cause the alterations in the qualities of the vital fluid; for to such organs ought the chief remedial means be directed.

Treatment of the digestive organs.

The management of the *digestive organs* must always be of primary importance; commencing with such means as will contribute to the formation of good chyle,—a judicious system of *dietetics*.

From the constant changes in the blood which derangements of the incrementitious and excrementitious processes create, must arise those varied feelings of health and of mental and bodily activity which we all daily experience. Hence by regulating the diet, the power we have to preserve both mental and corporeal vigour.

As the *fibrine* is abundant in proportion to the strength of the body; so in the treatment of those diseases where there is that feeble state of the frame which indicates a diminution of fibrine in the blood, we can supply the system with the kind of food which contains a large proportion of that constituent of the blood.

Of no less importance will be an appropriate use of *stomachics*, *hepatics*, and *purgatives:* their administration should be conducted according to the principles which have been already pointed out, and by an attentive discrimination of the peculiarities of each case.

There are also changes in the blood, which can be corrected by *diuretics* and by *dermatics ;* the mode of administering which has also been explained.

Besides the means necessary to improve and regulate both the incrementitious and excrementitious processes, those medicines which change the constituents, or which correct any vitiated conditions of the blood, are essential auxiliaries in the treatment of the heart's functional diseases.

Although the operation of particular medicines cannot be explained, yet experience has taught that some functional ailments of the heart, produced by changes in the blood, are relieved by particular medicinal substances. Thus the curative effects of the *alkalis*, *mineral acids*, *cod-liver oil*, and of *iodine*, as well as of some vegetable substances, as *sarsaparilla*, *dulcamara*, and *cinchona*, in gouty, rheumatic, syphilitic, and scrofulous affections; and the benefit of preparations of *iron* and *copper*, in chlorosis and anæmia, are all perfectly established.[1]

Here I may allude to the difference in the effects of *tonics* and *astringents*, where the qualities of the blood are changed, and where the nervous system is alone affected. In disorders of the heart, whenever the blood is unhealthy, from some defect in the organs of incretion, tonics, such as iron, copper, and quinine, are essentially useful; but in nervous affections they are equally hurtful; whereas in nervous affections of the heart, relief is obtained from the use of *ammonia*, *camphor*, *hydrocyanic acid*, and from those medicines which tranquillize the heart.

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[1] Cod-liver oil differs from all the other oil of the fish. It contains, according to Ure, bile, which accounts for its stomachic qualities.

"Almost everywhere, making certain allowances for some general conditions and humidity of the place, we arrive at this result, that there is a correspondence, parallel between the state of the *ioduration* of the air, the water, the earth, and its products, and the number of individuals attacked by goître."—*Researches as to Iodine,* by M. AD. CHABIN. 1854.

But the vitiated elements in the blood which constitute diseases not having been revealed, it could not be anticipated that chemical science could have suggested therapeutic agents, by which unhealthy ingredients in the blood could have been decomposed or rendered harmless. When we reflect how exceedingly minute are the quantities of matter by which the blood may be changed, and how incomprehensible are the processes of the vital laboratory, it need not be wondered that a knowledge of the nature of such noxious ingredients in the blood should have been, as yet, beyond the reach of human investigation.

In fine, though we have legitimate grounds for rejecting the hypothetical doctrines of Boerhaave, and the untenable notions which the humoral pathologists entertained of an "alkalescency," "acidity," "acrimony," and "putrescence" of the fluids, it must be acknowledged that, even up to the present day, neither physiological nor chemical science has been able to explain the true nature of the changes which the blood undergoes in health, as well as in sickness.

Although the altered state of the blood may have been the primary cause of a disordered action of the heart, it also happens that the interior surface of the heart's parietes sometimes becomes more or less irritable; so that *neurotics* should in such cases be given, in order to allay the irritability of the *endocardium*. In the same manner, as an alkaline medicine combined with opium allays both a morbid secretion from the kidneys, and an irritable state of the bladder; or that tenesmus is subdued by opiates, whilst appropriate medicines are being at the same time given to correct the morbid secretions of the mucous membrane of the alimentary canal, or of the liver, so will neurotics, especially *camphor*, *ammonia*, and *hydrocyanic acid*, be advantageously combined with *hæmatics* in the treatment of functional disturbances of the heart.

Much, too, depends on the *air* which we breathe; for notwithstanding the atmospheric air contains the same proportion of oxygen and nitrogen in all situations, yet there are other elements which, although they have not been defined, undoubtedly exist in the atmosphere, and have a great influence upon the animal economy.

In the treatment of disorders of the heart arising from changes in the blood, we ought not, therefore, to neglect the benefit which may be derived from the changes on the vital element which are produced by *climate*.

"The national character and the grave and gay dispositions of men are dependent, in a very high degree, on climatic influence. The poetry of the Greeks, and the ruder songs of the primitive northern nations, owe great part of their peculiar characters to the aspect of the plants and animals seen by the bard, and the mountains and valleys which surround him, *and to the air which he breathed.*"

Humboldt's *Physiognomy of Plants.*

When the functions of the heart have been disordered from the qualities of the blood being changed, there will also be sometimes more or less difference in the *quantity* contained in the heart's cavities; and in such cases great benefit will be derived from the abstraction of a small quantity of blood by *leeches*, from the precordial region. Should even the quantity of blood within the heart not be greater than is required for health, yet that quantity may be superabundant in disease, so that the abstraction of a portion of it will be useful.

The employment of blood-letting in cases of this description is, indeed, a nice point to determine. But whenever the propriety of the measure becomes a matter of doubt, it is generally a safe rule to apply a few leeches, as the loss even of a small quantity of blood may be essentially beneficial.

Case.

There is one symptom in the maladies which we are considering, which, I would venture to affirm, seldom fails to point out the propriety of abstracting blood. Whenever a spontaneous hæmorrhage has taken place from the æthmoidal, from the pulmonary, or from the hæmorrhoidal vessels, it may be considered as an effort of the *vis medicatrix* to relieve some congestion; and in such cases the application of one or two leeches to the precordial region will seldom fail to assist in relieving the heart. "My son," says Wierius, "while at Bologna, pursuing his studies, had this afflicting *palpitation*, accompanied with a capricious, frequent, and intermitting pulse; but by bleeding, which

Morgagni.

the older physicians never neglected, and care, and relaxation from his studies, he got quite well."

On the other hand, serious mischief has often arisen from the improper use of blood-letting; a tumultuous action of the heart and uneasy sensation in the head, produced by a diminished proportion of *arterial* blood having often led the incautious physician to abstract blood, the effect of which has been to lessen, in place of adopting those means which would increase, the action of the heart.

CHAPTER XLII.

DISEASES OF THE HEART FROM DISTURBANCES OF THE NERVOUS SYSTEM.

Phenomena and causes of the nervous affections of the heart; they arise either from disturbances in the cardiac plexus, in the cerebro-spinal, or in the ganglionic nerves; general character of these classes of nervous affections; affections of the heart caused by diseases of the cardiac nerves; illustrated in angina pectoris and palpitation; pathological inferences; affections of the heart caused by disturbed associations of the nerves of the ganglionic system; their physiological and anatomical symptoms; diagnosis and treatment; the sympathetic affections; their symptoms, diagnosis, and treatment.

General observations.

HITHERTO our inquiries have been directed to those disorders in the heart's functions which are produced by changes in the quantities and in the qualities of the vital fluid; but there remains to be considered another class of functional disorders which depend upon the influence of the *nervous system*,—an influence which is exercised on the heart, either directly by the cardiac plexus of nerves, by the cerebro-spinal nerves, or by the medium of that sympathy which subsists between the heart and the other organs with which it is associated by the ganglionic nerves.

Different classes of the nervous affections of the heart.

Derangements in the heart's functions from diseases of the nervous system may therefore, with propriety, be subdivided into three classes.

1*st*, The action of the heart is deranged by a disturbance in the functions of the cardiac plexus, the proper nerves of the heart.

2*d*, By a derangement in the function of the nerves of the cerebro-spinal system; and,

3*d*, By a derangement in the functions of the nerves of the ganglionic system.

Bichat, *Anat. Générale.*

This arrangement will, I think, be found practically useful, and consistent with physiological science; for, though some may not admit that the ganglionic is independent of but is subordinate to the cerebro-spinal system, yet, in a pathological point of view, they may be considered as separate and distinct; one class of diseases arising in the great nervous centres, and communicating directly with the cardiac plexus; and another arising from the relation which subsists between the cardiac nerves and those viscera which are supplied by nerves of the ganglionic system.

But, whilst admitting this division of the nervous system in our pathological inquiries, we must not therefore lose sight of the intimate relation which subsists between the cerebro-spinal and ganglionic nerves,—a relation which is established by the ganglionic system being formed by nerves from both of the great nervous centres. It is by this relation that we can explain the phenomena of many nervous diseases of the heart.

Influence of the cerebro-spinal system,

I have already endeavoured to point out the effects of derangements of the *cerebro-spinal* system upon the heart, and to show that the consent of the two vital organs, the brain and the heart, also depends both on the connexion, which subsists between the heart and the brain, in virtue of nervous filaments, and on the influence of the blood on the brain.

The influence of mental emotions on the heart's functions has already been fully explained; and in all the diseases of the brain and spinal cord, various changes are produced in the functions of the heart.

and of the cardiac plexus.

Influenced as the actions of the heart must be, through the medium of the nervous filaments which come from the spinal cord, it has also its special nerves, the various conditions of all which influence its functions; whilst the cardiac nerves regulate and control the actions of the heart, the heart, in its turn, when its functions are deranged, disturbs the *nerves* of the heart.

The cardiac plexus has both sensory and motor.

The progress that has been made in physiological science may essentially contribute to assist our investigations on the pathology of the nerves of the heart. For, as in diseases of the spinal cord, the sensory and the motor columns are separately affected, so it will be found, that in one class of the nervous diseases of the heart, the *sensory*, and in the other the *motor* branches of the cardiac plexus, are disordered.

The morbid condition of the *sensory* nerves are characterized by uneasy sensations and pain ; and when the *motor* nerves are affected, there is an inordinate muscular action. Of these phenomena we have striking illustrations : of the first class, in the *angina pectoris*, and in the second, in *palpitation*. At the same time, it should be noticed, that both systems of nerves may be affected in particular examples of disease, as is often observed in the nerves of other organs.

Morbid sensations of the cardiac nerves.

In the first class of these affections of the *cardiac nerves*, or of their *sensory* branches, there is a feeling of anxiety and uneasiness, sometimes amounting to severe pain in the region of the heart, frequently extending along different branches of the nerves of the chest, neck, and particularly those of the left shoulder, whence they extend down the arm. The degree of pain, however, which those suffer who are afflicted with a disease of the heart, is not always to be taken as a just criterion of the extent or danger of the malady; many lingering ailments having no influence on the *sensory* nerves.[1]

Angina pectoris.

The painful sensations to which the name of *angina pectoris* has been given, is a vague term, like that of palpitation or headache, when employed to signify a distinct disease ; whereas, it merely expresses some symptoms which are common to many of the heart's maladies. There is, indeed, no affection of the heart the pathology of which has been rendered more obscure than *angina pectoris ;* a confusion which has arisen, not only from symptoms having been attributed to very different morbid conditions of the heart by different observers, but also from all those symptoms which are described as appertaining to angina being met with in many organic as well as functional diseases of the central organ.

Consult the writings of Parry, Jenner, Heberden, Morgagni, and Haller.

That such an assemblage of symptoms should be always caused by a change in the structure of the *coronary* vessels, to which angina has been generally attributed, is not the case ; for there are abundant proofs of these vessels being greatly diseased, and not accompanied with neuralgic symptoms. There are also other diseases of the heart's apparatus, such as those of the valves,

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[1] Harvey observed in a person whose heart was laid bare, that it had little sensibility.

CHAP. XLII. where no alteration had taken place in the coronary arteries; notwithstanding that all the symptoms of *angina pectoris* were present.

We may therefore legitimately conclude, that as the symptoms of *angina*, each and all of them, appertain to many of the morbid changes in the heart's structure, in which the cardiac nerves are involved, the name is inaptly employed to designate a disease of any particular tissue of the heart. The only circumstance which can be adduced to corroborate the opinion, that the painful feelings in the cardiac nerves are caused by an ossified state of the coronary arteries, is the juxtaposition of these vessels with the cardiac nerves throughout their whole course: for the cardiac nerves not only accompany the arterial trunks, but "they pass into the muscular parietes of the heart along with the coronary vessels; and the nervous filaments can be traced as far as the third, or even the fourth subdivision, of the arteries. Here we lose sight of them even in the hearts of the largest animals."

Bichat, *Anat. Des.*

Consistent with these views of the nature of the nervous affections of the heart, and of the misapplication of the term *angina*, I will not enter upon a lengthened detail of those symptoms which have been described by different authors as constituting *angina* a particular disease of the heart. These symptoms will be mentioned in the account to be given of the different diseases in which such symptoms are manifest.

Morbid actions of the heart's muscles.

Next let us consider those functional disturbances of the heart which depend upon a morbid condition of the *motor* nerves.

The heart, like other organs, such as the stomach, the intestinal canal, or urinary bladder, often becomes extremely irritable, by which irritability its muscular contractions are increased, both in number and in force. This irritability may arise, as I have already shown, either from the excessive stimulus of a vitiated blood, or from an irritable condition of the heart itself. "For the irritability of the muscular fibres of the heart is influenced by the nerves, as those of other muscles are by the nerves distributed on them."

Portal.

The increase in the number and force of the muscular contractions of the heart points out the system of nerves which is affected; and as neuralgic affections characterize a disordered condition of the *sensory*, in the same manner the number and force of the contractions of the heart point out the condition of the *motor* nerves. Pathological phenomena are quite sufficient, without the aid of the knife of the anatomist, to prove that nervous filaments from the motor column, as well as filaments from the sensory column of the spinal cord, are distributed on the heart. The morbid condition of the filaments of the motor nerves of the cardiac plexus must therefore be the direct cause of all the changes which are observed in the heart's impulse.

Changes in the heart's impulse.

Whether the muscles of the heart be morbidly excited by the cerebro-spinal, by the ganglionic, or by the cardiac nerves, the changes in the heart's *impulse* will be always of the same character, so that, when the beatings of the heart are so intense as to be felt by the sufferer, the term *nervous* palpitation has been aptly applied.

There is no more frequent symptom in the functional disorders of the heart now under consideration than an increase in its *impulse*, and this is sometimes so much increased that the movements of the heart are perceptible not only to the patient, but cause a motion of the parietes of the chest to be visible to an observer. However, the impulse of the heart may be very considerably increased without being felt by the patient, and often it can only be perceived by him when he is in a horizontal posture. The feeling of *palpitation* ought not, therefore, to be always taken as a measure of the intensity of the impulse; as that may, to a certain degree, depend upon the sensibility of the heart itself, or of the contiguous parts of the chest.

Even though there be no distinct palpitation in some nervous affections of the heart, there is frequently a "fluttering" or "throbbing" sensation in the chest, accompanied sometimes by uneasiness and a distressing feeling of depression approaching to fainting.

The palpitations which accompany these nervous diseases are very irregular and variable in duration; sometimes continuing only a few minutes, and frequently for several days. This, contrasted with the permanency of the increased impulse in many *organic* diseases of the heart, is a useful diagnostic character; for, though palpitations may sometimes take place in a paroxysmal form in organic diseases, yet the fits are usually brought on by some mental or bodily excitement.

Changes in the arterial pulse.

During a paroxysm of palpitation, the *arterial pulse* undergoes a corresponding change with that of the heart, becoming rapid and tumultuous but easily compressed ; and sometimes the pulsations of the large arterial trunks are perceptible even to the patient, especially those of the carotids and abdominal aorta. The throbbing of one of the temporal arteries in the common "bilious headache," arising from excrementitious matter lodged in the alimentary canal, is a striking illustration of the sympathy which subsists between the digestive organs and particular portions of the arterial system.

From similar causes, the action of the heart sometimes becomes very irregular, creating great anxiety to the sufferer, an "intermittent pulse" having been frequently considered as a symptom pointing out the presence of an organic disease.

Sympathetic affections.

Having given a general view of the disturbances of the heart which depend upon the influences of the cerebro-spinal and the cardiac plexus, we have now to consider the functional disturbances, which are caused by the influence of the diseases of those organs with which the heart *sympathizes*, and which, like the heart, are supplied with nerves of the ganglionic system. It may however be observed, that although sympathetic affections of the heart are caused by diseases in the organs of organic life, yet it must not be concluded that the diseases of these organs will always be followed by disturbances in the heart: in one person the heart, in another the brain, and in another the intestinal canal, may be deranged by some disorder of the stomach.

The sympathetic affections of the heart form a most important class of its functional diseases: not only do they frequently occur, but they often assume such a character as to alarm the sufferer, as well as perplex and mislead the physician.

Of the affections caused by diseases of the organs with which the heart sympathizes, the most remarkable are those which arise from disorders of the digestive, the cutaneous, the genito-urinary, and the capillary systems, all which systems are supplied by ganglionic nerves. As, therefore, the heart is also supplied with nerves from the ganglionic system, and as that system derives nerves from several cerebral as well as from the spinal nerves, we can explain how disturbances of the heart are caused by *sympathy*, as well as by the influence of the mind.

Symptoms.

Symptoms and diagnosis derived from the lungs.

I have already endeavoured to point out, how difficult it is in many instances to discriminate primary affections of the heart from affections of the *lungs*, in consequence of the intimate relation between these two vital organs; a relation which is established not only by their vascular connexion, but likewise by both organs being supplied with nerves of the ganglionic system. It may therefore be anticipated, that the functions of the lungs will suffer during an attack of nervous palpitation; and it is in virtue of the nervous as well as of the vascular connexion between the heart and lungs, that we can explain the condition of the organs of respiration and circulation in asthma, and likewise in some diseases of the heart, where there is much embarrassment in breathing.

From the digestive organs.

Diseases of the *digestive organs* often cause a derangement in the functions of the heart; a subject that has already been considered at some length. Functional disturbances of the heart are frequently caused by particular kinds of food, or by undigested food, and likewise by medicinal substances; it is therefore of importance always to inquire into the existence of any such causes, as the true nature of the disease will thus be ascertained.

Case.

"Early one morning I left town, having partaken of scarcely any breakfast. About two o'clock a fellow-traveller offered me part of a cold mutton-pie. A few minutes after I had taken it I was seized with a violent palpitation of the heart and intermitting pulse. I returned home in about a week, still suffering from palpitation of the heart. In getting off from the top of the coach, my foot slipped, and I fell backwards head foremost to the ground, without sustaining any injury. The palpitation which I had felt just before the accident, ceased for several hours. It did not finally leave me for more than a fortnight."

From the portal system.

Besides sympathetic affections of the heart produced by disorders in the alimentary canal, disturbances are caused by changes in the *portal system;* all the symptoms of which are referrible to the right heart.

Although the position of the heart is changed by its natural movements, and though in the various tribes of animals there are peculiarities of structure to enable it to vary its position in reference to their habits, without disturbing the circulation, yet in man the heart's functions are frequently disturbed by a change of posture, or by an over-distended stomach. The effects of a large meal before going to bed in disturbing sleep, and many of the uneasy feelings from flatus, are well known to be caused by the overloaded stomach pressing upon the heart.

The influence which the *genito-urinary* organs exercise on the heart is very remarkable; an influence which may be caused either by the direct agency of the brain, or by the sympathy which subsists between the heart and the organs of organic life.

In all nervous affections of the heart, the quantity of the urinary secretion is more or less increased: the only change in its constituents is a larger proportion of water;—a state of the urine which has always been considered a useful diagnostic symptom.

From the uterine system.

There are no sympathetic affections of the heart more frequent than those which arise from derangements of the *uterus*. If the menstrual flux be interrupted, the circulation becomes disturbed, and the heart's functions are no less influenced, when that discharge is morbidly increased, or when it comes on at an improper period. Hence irritability of the heart so frequently occurs towards the age of puberty, and also previous to, or during the menstrual flux.

It is this influence of a disordered uterus on the heart which causes many of the more remarkable symptoms of the hysteric paroxysm; the change in the heart's functions producing syncope, and deranging the functions of the cerebro-spinal system; disturbances of the circulation which the economy restores by the vomiting and convulsions so remarkable in hysteria.

During *pregnancy* the functions of the heart are likewise, in many instances, very much disturbed; to this are to be attributed the nausea and paroxysms of vomiting which often accompany pregnancy, and which are relieved by moderate bleeding, together with the use of those remedies that tranquillize the heart.

From the cutaneous system.

The influence of the *cutaneous nerves* upon the heart is exemplified if they be irritated or excited; as when the skin becomes the seat of pain, or titillation is employed sufficient to cause laughter. In either case, the action of the heart is disturbed, and this has been known to proceed even so far as to cause convulsions and death.

The influence of the cutaneous capillaries upon the heart we see illustrated in the effects of extreme cold or heat; which, by interrupting the functions of the capillaries, disturb the functions of the heart. In all febrile diseases, whether idiopathic or symptomatic, the heart's action is more or less increased during their acute or inflammatory stage.

The physiological symptoms.

Those nervous affections which are properly considered *sympathetic*, are accompanied by symptoms derived from the organ that is *primarily* affected.

When the action of the heart is deranged, and is accompanied by a disordered state of the digestive organs, there is no class of symptoms more characteristic of the disordered circulation being sympathetic, than a derangement of the alimentary canal. Most persons suffering from an organic affection of the heart, have little disturbance in the functions of the alimentary canal; so that the presence or absence of such ailments assists in distinguishing sympathetic from organic diseases of the heart.

Diagnosis.

Diagnosis.

When we consider the difficulty of discriminating the functional from the organic diseases of the heart, how much more difficult must it be to distinguish the functional diseases from one another. For as the quantity of the blood is constantly changing, and its qualities are never the same in health and in disease; and as the functions of the heart are also disturbed by the varied influence of the nervous system, all those causes which disturb the heart must produce such an endless combination of symptoms, that it becomes no easy task to distinguish the functional disturbances from one another. "The heart beats 500 sorts of pulses in an hour; and hunted into such continual palpitations, through anxiety and distractions, that fain it would break."

Hervey.

When we review the various symptoms which accompany the functional maladies of the heart arising from disturbances in the nervous system, there is scarcely one of them which can be pointed out as pathognomonic of a particular disease; as the physical signs which are present in the functional diseases are also met with in many organic affections.

Another reason why the functional diseases, which we have been considering, are so difficult to be discriminated from one another, arises from the numerous combinations in which they appear. The functions of the heart may be disturbed by the cerebro-spinal, the ganglionic, or the cardiac plexuses of nerves; or all these may be simultaneously deranged, and may also be accompanied by changes in the quantity or qualities of the blood. The age, the sex, the temperament, the history, progress, and duration of the disease; the condition of the organs of animal as well as those of organic life, all become important diagnostic characters in the sympathetic affections of the heart. The morbid alterations of the blood, the condition of the organs of incretion and of excretion, the state of the *cerebro-spinal*, the *ganglionic*, and the *cardiac nerves*,—each produces symptoms, many of which are so much alike, that there are numerous difficulties to surmount in forming a correct diagnosis.

Changes in the sounds.

The *sounds* in nervous affections of the heart vary both in their duration and intensity; and when it is considered that such changes in the sounds must be the effects of corresponding changes in the currents of the blood, and not produced by changes in the heart's apparatus, but by irregularities in its actions from nervous irritation, it will be readily understood how varied must be the character of such sounds.

Both the systolic and diastolic sounds may become more intense, and are sometimes sufficiently audible to be perceived by the patient.

"Sanctius Velasco, son of the Count Velasco, had a palpitation of the heart so terrible, that I and many bystanders often heard it distinctly, *as if a stone had been plumped into a jug half full of water*. Yet this boy got entirely well."

Morgagni.

"In nervous palpitations, the first impressions which the ear receives, when applied to the cardiac region, show that the heart has not acquired greater dimensions. The *sounds*, though clear, do not extend over a greater space; and the *shock*, though at first it appears violent, afterwards there is but little impulse, for it does not elevate the head of the observer. This last sign appears to me the most important and the most certain of all, taking along with it the increased frequency of the pulsations, and which are generally from 84 to 96 in a minute."

Laennec.

The "bellows" sound is met with in those changes in the heart's action which take place during a hysteric paroxysm; but this morbid sound vanishes soon after the attack. Here it may be remarked, how difficult it is to form an accurate diagnosis from the anatomical symptoms, the "bellows" sound being met with both in many organic and functional diseases.

This condition of the heart is frequent in young people, especially about the age of puberty; in those of a nervous temperament, and in those also who are exposed to great mental excitement.

Imperfections, both in the functions of incretion and excretion also predispose to these nervous affections of the heart; and the movements of the heart become very tumultuous when there has been a diminution in the quantity or a change in the quality of the vital fluid.

There are, however, organic affections of the heart chiefly in young persons,—the effects of measles, scarlatina, small-pox, diseases which are seldom met with in those advanced in life. Whilst those in advanced years are most liable to organic affections of the organs of circulation, the young, especially those of the nervous temperament, are most subject to diseases of the nervous system.

Treatment.

Treatment.

The treatment of the functional diseases of the heart is perhaps one of the most difficult branches of the healing art. The numerous causes by which they are produced, their combinations with each other, their complication with organic diseases, render it frequently very difficult to decide on appropriate remedies, still more so to decide on the order in which they should be administered in each individual.

The treatment of the nervous affections of the heart must, in accordance with the pathological views I have now pointed out, necessarily vary, according as they are caused by diseases of the nervous centres, of the cardiac plexus, or of those organs which are supplied by the ganglionic system.

The irritable state of the heart, which is accompanied by an increase of its impulse, whether perceptible or not to the patient, may be tranquillized chiefly by the exhibition of *neurotics*. The diluted *hydrocyanic acid*, *belladonna*, *digitalis*, *valerian*, *camphor*, and *chloroform*, will each be found useful in particular cases.

Decided benefit is often derived from the *hydrocyanic acid.*

A youth passed many sleepless nights from a palpitation which he felt whenever he lay in a supine posture. Three minims of the dilute hydrocyanic acid of Scheele never failed to produce a calm and uninterrupted sleep.

Orange-flower water is in common use as a soporific; and, in many instances, when the heart has been too much excited, it is beneficial in procuring *sleep.*

Belladonna is often of great use when applied externally as a plaster, either upon the region of the heart or between the shoulders.

The nervous temperament.

The shower-bath, and sponging over the trunk of the body and arms with cold water and vinegar, or common salt, are also useful remedies.

In almost all cases where the action of the heart has been disturbed by nervous excitement, the blood itself being unhealthy, great benefit will be derived from *hæmatics*, of which the salts of iron, copper, and zinc, and the mineral acids, have long been justly held in repute.

The condition of the digestive and genito-urinary organs also demands particular attention. The mode of administering the medicines, which are employed in the diseases of these organs, has already been pointed out.

In spasmodic affections of the intestinal canal, it is well known that its contents are with difficulty expelled, even with the assistance of drastic purgatives; whereas, if the spasm be first relieved by a neurotic medicine, the bowels then readily evacuate their contents. If during parturition the uterus be affected with violent spasmodic pains, the administration of large doses of opium, by allaying the pain, promotes the natural process of expulsion. It is the same as regards the heart: in those affections where the heart's action has been extremely increased, the circulation should first be tranquillized by a *neurotic*, after which those medicines may be employed which improve the condition of the digestive organs.

When considering those functional diseases of the heart where there is an increased quantity of blood, and where its qualities are also changed, I have pointed out the advantages which are to be derived from *blood-letting*, and the rules which should be followed in the use of it.

It is in the nervous affections of the heart that this powerful therapeutic measure has produced such mischief.

"A boarding-mistress, having a slight palpitation of the heart, was bled, with some appearance of relief; but after two days her palpitations returned with such violence, the breast seemed at every stroke to be lifted up; she had withal pain, fever, and difficult breathing. They continued bleeding her first in the arm, which did no good; then in the foot, which was absolutely fatal; for, in an hour after, she died, the pulse becoming quicker instantly, and falling gradually lower and lower, and giving less resistance to the finger till she expired! In her viscera, both of the belly and of the thorax, everything was entire, sound, and natural." Morgagni.

In the treatment of the sympathetic affections of the heart, our chief attention should be directed to remedy the morbid condition of that organ with which the heart sympathizes; and at the same time to tranquillize the excited heart by *neurotics*, or to improve by the exhibition of *hæmatics*, any morbid change that may have taken place in the qualities of the blood.

When the *stomach* itself has been much deranged, I have frequently observed great benefit derived from an *emetic*,—the vomiting, besides its effects on the circulation, sometimes removing from the stomach undigested food, or evacuates some excrementitious fluids.

Mercury combined with *antimony*, or antimony alone, has a powerful effect in evacuating morbid secretions of mucus which are often accumulated in the intestinal canal. These medicines have also a powerful influence in correcting the biliary secretion.

The mercury should always be given cautiously, for, though in some patients decided benefit may be derived from a few doses, yet, if carried further, the heart is rendered irritable. *Purgatives* are also essentially useful remedies in nervous diseases of the heart; but they must be given according to their effects in removing excrementitious matters from the intestinal canal. The excitement which the retention of feculent matters sometimes produces on the heart, and the speedy restoration of its healthy condition whenever they are removed, is indeed extraordinary.

The diseases of the uterine system, which have so powerful an influence on the heart, may be much relieved by medical treatment. For this purpose, those remedies should be employed which increase, diminish, or improve the qualities of the menstrual flux.

Treatment.

In the treatment of neuralgic pains of the heart, besides the administration of such remedies as may be required to subdue that state of the heart, of which the painful sensations are the symptoms, those *neurotics* should at the same time be given which act on the *sensory* nerves, such as *chloroform*, *hydrocyanic acid*, and *digitalis*. It is in such cases that the *galvanic electricity* has been extolled by Laennec.

The influence of gratifying the senses, in subduing nervous excitement, ought not to be disregarded in the treatment of these disorders of the heart. The effect of having before us objects that please the *sight* is remarkable; hence the custom so common amongst the ancient Romans, of making choice of nurses for their children with a pleasing countenance. The pleasure derived from the exercise of the sense of *touch* is no less striking. The gratification of the sense of *smell* has likewise a powerful influence. The unfortunate prisoner is sooner reconciled to any privation, than to the want of "snuff." The pleasure of gratifying the *taste* is too well known, and forms a most important element in all civilized societies. The soothing effect of the "sweet sounds of music" on the sick, as well as on those who are in health, is well known; and on the insane it is equally remarkable. Montaigne always awoke his child with music. It is resorted to, along with words, to express the most tender and the most impassioned feelings; to add cheerfulness to the feast; and to excite courage in the warrior!

"Her martial sounds can fainting troops inspire
With strength unwonted, and enthusiasm raise;
Infuse new ardour, and with youthful fire
Urge on the warrior."

It uplifts the soul to devotion!

"Oh! surely melody from heaven was sent,
To cheer the soul when tired with human strife,
To soothe the wayward *heart by sorrow rent*,
And soften down the rugged road of life."

Henry Kirk White.

CHAPTER XLIII.

THE ORGANIC DISEASES OF THE HEART.

Observations on the organic diseases of the heart; each tissue may be diseased separately, and several may be affected simultaneously; the specific character of organic diseases of the heart; comparative view of the diseases of the right and left hearts; essential differences in their diseases; physiological and pathological illustrations; general character of the diseases of the right and of the left heart.

General Observations.

Thus far I have now given a general view of those disturbances of the heart's functions, which are caused by alterations in the *quantity* and *qualities* of its blood; as well as of disturbances depending upon disorders of the *nervous* system. But the functions of the heart are likewise changed by the various morbid changes in the different tissues of which it is composed; thus constituting its *organic* diseases.

In investigating the organic diseases of the heart, I shall consider all those which affect each particular tissue; at the same time, in the heart, as in other organs composed of several distinct tissues, there are many diseases which are not always limited throughout their progress to one tissue, but in which a greater number of its tissues are sooner or later involved.

Diseases may likewise affect the same tissue either of one or of both hearts simultaneously, and, though the functions of the pulmonic and systemic hearts materially differ, yet the component parts of each being nearly alike, their morbid changes are also similar.

Whenever a change takes place in the structure of any portion of the apparatus of the central organ, there must necessarily be caused some hindrance either to the ready entrance of the *venous* blood, to the exit of the *arterial* blood, or the vital stream will be altered in passing through the heart's cavities, from some change that may have taken place in the form of the auriculo-ventricular orifices. Therefore we find that one of the most remarkable effects of a change in the structure of the heart is an alteration in the distribution of the blood; this is sometimes caused by a comparatively small structural change, whilst at other times a very extensive disorganization produces little interruption to the great function of circulation.

Their specific character.

Except those morbid changes, which may undoubtedly result from functional diseases long continued, or which are caused by a wound, all the organic affections of the heart are decidedly of a *specific* kind, arising either from gouty or rheumatic inflammation, or from exanthematous diseases, such as measles and scarlet fever;—and sometimes, though rarely, from scrofula, fungus hæmatodes, and fungus melanodes.

Difference in the diseases of each heart.

Reflecting on the numerous diseases of the heart, we are led to inquire, not only into those of its different tissues, but also into those maladies which affect each of the two hearts. Although the elementary tissues which compose both hearts are nearly similar, the muscles of each merely differ in bulk; they are both covered by the pericardium; they are both supplied by the same arteries and nerves; the lining membrane of the left heart resembles the lining membrane of the arteries, and that of the right heart is like that of the veins,—yet we find that the diseases of each heart are accompanied by very different phenomena; that the left is far more frequently diseased than the right; and that the two hearts may be considered pathologically as well as anatomically distinct the one from the other.

To comprehend these differences of the two hearts, we must refer to their mechanism and functions in the healthy state of the body. I have already pointed out, at some length, in what these differences consist. But whilst a distinct line of demarcation may be drawn between them, still we are never to lose sight of the intimate union of their structures, nor of the co-operation in their functions, through the medium of the lungs,—in fact, that they are portions of one complicated machine, any part of which, when once disordered, must more or less influence the functions which are performed by the whole apparatus.

In many affections of the heart this distinction is well marked;

for though, as has been said, the functions of the two hearts are intimately blended, yet the *systemic* circulation may be disturbed without causing much perceptible interruption to the pulmonic circulation; and the *pulmonic* may be much changed, whilst that of the systemic circulation is comparatively little altered.

The differences in the functions of the two hearts it is essential to examine when investigating their disorders; as it will appear no pathological phenomena can be more striking, than those which may be observed either when the right or the left heart is diseased.

If there be any disturbance in the *systemic* heart, then we may expect to find either an increase or a diminution in the supply of arterial blood to the different organs. In one whose *left* heart only is disordered, it is very striking to notice how little apparent change there is in all the vital functions when the body is perfectly tranquil, and when there is a diminished supply of arterial blood to the various organs. For the support of life, it is extraordinary how small a stream of blood seems to suffice: and when the voluntary muscles are placed in a state of relaxation, which happens when the body is in a supine posture, and the respiration is not hurried, there is generally very little suffering or even external character of disease.

When the *pulmonic* heart cannot impel the blood with its usual force through the pulmonary vessels, the venous system becomes congested; a condition which is marked by a livid colour and coldness of the skin, and a congested state of the subcutaneous veins, embarrassment in breathing, and difficulty in lying in a horizontal posture from a congested state of the pulmonary capillaries.

Nothing can be more remarkable than this difference in the disturbances of the circulation in the two hearts,—differences which are readily explained by a reference both to their mechanism and functions.

Its diseases.

Independently of such diseases as are confined either to the pulmonic or to the systemic heart, each of the heart's tissues is liable, as similar tissues are in other organs, to be affected separately, or they may be all involved in one disease. Whenever any part of the structure of the heart is changed, some of its functions become disturbed, and various alterations take place in the distribution of the blood. If, for example, from a change of structure, the venous blood cannot readily pass from the right auricle into the right ventricle, or from the right ventricle into the pulmonary artery, it will be naturally anticipated that either of these changes will produce some irregularity in the distribution of the *venous* blood. So, also, when either the left auricle or the left ventricle cannot propel the blood in its natural current, or with its usual velocity, a variety of symptoms will arise from a disturbance in the circulation of the *arterial* blood.

Characteristic of the differences in the diseases of the two hearts are the means which the animal economy employs to relieve the symptoms of each. This is exemplified in the hurried respiration and increased impulse of the heart, when the systemic heart is overloaded; and in the sobbing and sighing, and deep inspirations, when the pulmonic heart and the venous system are gorged with blood.

The curative effects of *spontaneous hæmorrhages* also point out differences in the diseases of each heart. We see how much the portal system and the congested *pulmonic* heart are all relieved by the *hæmorrhoidal* flux; how a congestion of the *systemic* heart is relieved by *epistaxis;* how *pulmo-cardiac* congestion is relieved by *hæmoptysis.* These different modes which the *vis medicatrix* employs to relieve the pulmonic and systemic hearts from congestion, point out an important law of the animal economy, which we should imitate in the treatment of diseases;—to abstract blood from the cardiac region, or æthmoidal vessels, when the left heart is gorged with blood; and from the hæmorrhoidal vessels, when the right heart and venous system are congested.

CHAPTER XLIV.

THE INFLAMMATORY DISEASES OF THE HEART.

The phenomena and causes of the inflammatory diseases of the heart; the different tissues which compose the heart may be separately inflamed; hence carditis, pericarditis, and endocarditis; the specific character of the inflammatory diseases of the heart.

Their phenomena and causes.

THE different tissues which compose the heart are subject to inflammatory affections like similar tissues in other organs; but there are phenomena of a distinct character by which they are accompanied; and these are derived from the special functions which the heart performs as the central organ of the circulation.

The muscular parietes, the pericardium, and the endocardium, may be each inflamed separately; hence nosologists have enumerated and placed in one genus, *carditis*, *pericarditis*, and *endocarditis*. At the same time, like inflammatory affections of the pleura, of the pulmonary mucous membrane, or of the parenchyma of the lungs, inflammation, sooner or later, and to a greater or less degree, involves more than one, and sometimes all the different tissues of the heart.

Inflammatory affections of the heart are accompanied by a train of phenomena, all of which arise and derive their principal character from changes in the heart's functions.

The irritable surface of the *systemic* heart causes the left ventricle to be excited in a morbid degree by the stimulus of the blood, just as an inflamed eye is irritated by the stimulus of light. The number of the heart's contractions are thus increased; and as a more rapid stream of the vital fluid is thrown, especially, into the respiratory and cerebro-spinal systems, respiration is quickened, the mind becomes restless and watchful, and there are various uneasy and painful feelings in the spinal nerves.

No less remarkable is the influence of an inflammatory attack upon the functions of the *right* heart, especially on the pulmonary circulation; its increased action, caused by its irritable condition, producing a quickened, hurried, and an embarrassed breathing.

The inflammatory affections of the heart are produced by similar causes, as inflammatory affections of other organs. They may generally be traced to a sudden chill from exposure of the cutaneous surface to or from breathing a cold and moist atmosphere; to sleeping in a cold damp bed; to cold and wet feet; or to the sudden suppression of an eruption of a purulent discharge, or of the menstrual or hæmorrhoidal flux.

Indisposing causes.

As may be remarked of inflammatory diseases in general, those of the heart are almost always preceded by some constitutional disturbance; more especially by a derangement in some of the other organs of the economy. Inflammatory affections of the adjoining viscera also affect the heart; and it is likewise greatly influenced by moral causes, which render it peculiarly liable to inflammation.

Of the predisposing causes of inflammatory affections of the heart, none are more frequent than a disordered state of the *digestive organs*. Food of an improper quantity or quality, or collections of excrementitious matter in the intestinal canal, and biliary derangements; all equally predispose the circulating organs to inflammatory attacks.

The same remark applies to the *uterine system*, derangement in that system rendering the heart, in many instances, particularly susceptible of inflammation.

The specific character of cardiac inflammations

But of all the predisposing causes of the inflammatory affections of the heart, by far the most frequent are those which are of a *specific* character. Common or idiopathic inflammation, properly so called, I have every reason to believe, very seldom affects any of the heart's tissues; the inflammations to which they are liable being either arthritic or rheumatic, those accompanying exanthematous diseases, or those where there is some hereditary peculiarity in the constitution.

Simple as *idiopathic* inflammation is, it is, indeed, seldom observed in any organ, except when it has been caused by wounds or accidents in persons in perfect health. But even in most of such cases there is some idiosyncrasy—some peculiarity of constitution which the injury as it were awakes, and which, sooner or later, never fails to modify the character of the inflammation. CHAP. XLIV. Such, however, is the almost endless varieties of disease, and so greatly do the characters of local diseases differ in every individual from the condition of his general health, temperament, and constitutional peculiarities, that we seldom observe even two examples of what may be strictly considered the same disease, which are in all respects similar. Neither do we find, that in several individuals, who have received a wound of the same extent, does the wound retain the same character for a lengthened period.

It is the same with the heart; for in the few instances of idiopathic inflammation which do occur, it will be invariably found, that besides the effects of common inflammation, changes sooner or later take place, which completely modify the character of the attack; all which changes are derived from the peculiarities in the patient's constitution, or from the state of his general health.

Inflammatory affections of the heart may affect only one of its tissues, or several of them may be simultaneously inflamed; the inflammations may be variously combined, or the lining membrane of only one of the hearts may be inflamed.

Carditis.

When the substance of the heart itself, or, more properly speaking, its *muscular* structure, is inflamed, remarkable changes take place in the muscular fibres. They become soft, pulpy, and apparently quite disorganized; but a suppurative process seldom takes place, the quantity of cellular tissue, which is interposed between the fibres, being extremely small, and much less proportionably than that in any other muscles.

Endocarditis.

Far more frequently do we find the lining membrane of the heart's cavities, and especially that of the left heart, inflamed; the inflammation exhibiting a very peculiar redness, and followed by changes in the structure of different portions of the membrane.

Pericarditis.

The external covering of the heart is more liable, than its muscular structure, to inflammation, though it is by no means so often inflamed as the endocardium.

The morbid alterations of structure which take place in both these tissues, are analogous to those which are met with in other inflamed serous membranes.

As in all organs composed of different structures, inflammation, however much it may be limited to one tissue of the heart, soon extends to those which are adjacent; so there is seldom an opportunity of observing, after death, either the pericardium or the endocardium alone in an inflamed state. We have sufficient grounds for entertaining this opinion by contemplating the phenomena observed in the inflammatory affections of other organs, such as those of the *eye*, where there is the advantage from its position, as well as from the transparency of its structure, of observing all the changes produced by inflammatory disease. In conjunctival inflammation we can observe a small point of inflammation gradually extending not only over the whole membrane where it has commenced, but spreading more or less quickly, and involving all the adjacent tissues.

Here I may remark, that, however minute may be the changes of structure which we are enabled to detect after death, or to observe in some organs during life, for all practical purposes such nice discriminations can avail little; the treatment of disease not depending either on the precise part affected, or altogether on its extent, but on that assemblage of symptoms which are created by the disease upon the whole animal economy.

Treatment.

The general principles on which the inflammatory affections of the heart are to be treated, are those which are employed in the treatment of the inflammatory diseases of the other organs; and at the same time, such remedial means should be had recourse to which have a specific effect in tranquillizing the action of the heart.

CHAPTER XLV.

THE GOUTY INFLAMMATION OF THE HEART.

General observations on gouty affections of the heart; the imperfect accounts hitherto given of gout of the heart; its frequency; analogy of gout with other specific diseases; phenomena and causes of gout; the tissues liable to be affected by gout; it affects the pericardium and the endocardium; the morbid changes produced by gout; a cretaceous-looking matter deposited in the tissues; this is either the phosphate of lime or the urate of soda; the blood in gouty patients contains the urate of soda; the metastasis of gout; its hereditary character; symptoms and diagnosis of gout; treatment of gout.

On gouty inflammation of the heart.

Let us first consider the *arthritic* inflammation of the heart, not only because it is by far the most frequent of all the inflammatory affections of that organ, and most within the reach of medical treatment, but also because, excepting a few cursory observations made by the elder writers, this important disorder has not been alluded to, even by those modern authors who have professed to collate compendiums of the diseases of the heart, nor by those who have compiled treatises on gout.

Baillie's Posthumous Works.

It is indeed remarkable that, amongst the numerous species into which nosologists have divided *gout*, especially by Sauvages, who divided it into several species, from the particular part of the body where it was seated, no mention has ever been made by any of them of an arthritic affection of the *heart.* Baillie, whose authority may be fairly taken as an index of the state of pathological knowledge of his time, says, "I think I have seen *one* case of gout in the heart." This is the more remarkable, when we recollect that Baillie was associated with the Hunters; and, from his intimate acquaintance with the preparations in their museums, must have been familiar with the morbid deposits in the valves and other portions of the serous membrane of the heart,—all which, I shall endeavour to show, are the products of gouty inflammation. Corvisart, in his valuable work on the diseases of the heart, has not even mentioned such an affection; Laennec has but slightly alluded to this disease; and, though a gouty affection of the heart has been noticed by Kreysig, yet no author, as far as I know, has given a detailed account of the phenomena of the arthritic inflammation of the heart; of its various symptoms; of the changes of structure which it produces, or of its appropriate treatment.

Heart's action always disturbed

So constant an attendant of *gout* is a change in the heart's action, from the earliest development of the symptoms, and throughout all its different phases, that it seems quite unaccountable, how this condition of the central organ should not have arrested the attention of pathologists, and that they should, in those affected with gout, have been satisfied with noticing only the changes in the arterial pulse, without at the same time observing the condition of the heart itself. To me it appears, that the influence of gout upon the heart explains many of the phenomena of this disease, which have hitherto been most imperfectly understood. The superficial manner in which this interesting subject has been investigated is the more remarkable; as I will venture to affirm, that seldom will any one be met with, who has ever suffered from gout in its usual form affecting a joint, in whom the action of the heart has not been also more or less disturbed, either before, during, or after the gouty paroxysm.

It is indeed surprising, that the changes which have been observed so constantly present in the arterial pulse of gouty persons, should have led pathologists not only to examine the state of the heart, but also the changes in its structure after death; as they would have found, that there were changes in the actions of the heart corresponding with those of the pulse, and that all the changes in the heart's tissues were analogous to those produced by gouty inflammation in other organs. So frequently, indeed, are such changes to be met with, that the morbid alterations in the structure of the interior apparatus of the heart are, I am convinced, far more frequently the products of arthritic, than of other inflammatory affections.

Many years ago my attention was first directed to the effects which gout produces on the heart from the appearances in the body of a military officer, who for a long time suffered from severe attacks of gout, in whom not only the thoracic aorta, but the pericardium was extensively ossified, and its surface covered with a cretaceous matter—morbid changes which are usually the effects of arthritic inflammation, and characteristic of it.

Analogy of gout to other specific diseases.

The many histories of gout, which have been published, have made it appear to be so complicated a disease as to lead to the supposition that it is unlike all other maladies. There is no order of phenomena to be observed in gout, which are not met with in other *specific* diseases. Comparing gout with *scrofula*, both chiefly affect particular tissues; both are preceded and accompanied by disorders of the processes of incretion and of excretion; both excrete a matter *sui generis;* both are hereditary; and both may be translated from one part of the body to another.

To scrofula.

No more, therefore, should gout be subdivided into different species than *scrofula.* Gout, whether it assume an *acute* or *chronic* type; whether it affect one *organ* or one *tissue* of an organ; whether it be confined to one part of the body or *translated;* whether its attacks be *regular* or *irregular;* whether it be *retrocedent* or *misplaced;* or whether it be *anomalous* or *hereditary;* nevertheless, in all these stages, and in all these varieties and forms, each of which has been considered by nosologists as a distinct species, and designated by a particular name, gout ought to be legitimately regarded as *one specific disease*, and its different *species* nothing more than modifications or phases of one and the same malady.

Such artificial divisions have led not only to erroneous views of the pathology of gout, but have rendered the principles of treatment exceedingly complicated; as we shall find that it matters not, in establishing a system of treatment, how the different forms of the disease may be designated, as they are all examples of one specific ailment variously modified by temperament, constitution, and other peculiarities in each individual; all requiring the same therapeutic means for their treatment.

Phenomena and Causes.

The tissues subject to gout.

Gouty inflammation, like other specific diseases, attacks only particular tissues; and, although it has been from the phenomena of gout, when affecting the synovial membranes and their superincumbent bursæ, that the descriptions of the disease have chiefly been given in systematic works, yet arthritic inflammation affects not only the synovial, and the serous, but also the mucous membranes and the skin.

The serous membrane and skin.

Of the *serous membranes*, we find the pleura, the peritonæum, the membranes of the brain, the capsules of the aqueous humour and crystalline lens, and the vaginal coat of the testis, all subject to gouty inflammation.

The mucous membrane and skin.

Both the *gastro-pulmonary* and the *genito-urinary mucous* membrane, as well as the skin, are also liable to arthritic inflammation. The mucous membrane of the bronchi, of the pharynx and alimentary canal; the mucous membrane covering the eyeball, as well as that lining the urinary passages, are all subject to inflammation, distinctly of an arthritic character, attacking individuals of gouty constitutions, and yielding to a system of treatment which clearly points out their true arthritic character.[1]

Reasoning, therefore, from analogy, and bearing in mind the natural structure of both the *pericardium* and *endocardium*, we are led to anticipate, that when gout affects the heart, the inflammation will be seated, not in its muscular structure, but in either of these serous membranes.

Morbid appearances.

Though it is after death that we are able to see the characters of gouty inflammation of the serous tissues of the heart, yet during life we can observe the peculiar bright scarlet tint of the inflamed skin covering a gouty joint. We have also a most favourable opportunity of observing, from the transparency of the organ of vision, all the morbid changes and progress of arthritic inflammation in the iris, and thus comparing arthritic

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Cullen, vol. i. p. 290.

[1] "The internal part most commonly affected is the *stomach*, which is then affected with anxiety, sickness, or violent pain; but sometimes the internal part is the *heart*, which gives occasion to syncope; sometimes it is the lungs, which are affected with asthma; and sometimes the head, giving occasion to apoplexy or palsy. In all these cases, there can be no doubt of the symptoms being all a part of the same disease, however different the affection may seem to be in the parts which it attacks."

iritis with *endocarditis.* When the eye is attacked with gouty inflammation, besides the peculiar red tint of the inflamed sclerotic coat, the serous membrane which lines the cornea, spreads over the surface of the iris, and extends over the anterior surface of the capsule of the crystalline lens, becomes dull and discoloured from effused lymph ; and, if the inflammation has been severe and of long duration, or if the attacks have been frequent, portions of the capsules of the aqueous humour and crystalline lens then become thickened, and in some instances are even ossified.

Now these morbid changes are precisely those of *arthritic endocarditis* and *pericarditis.* The lining membrane of the heart loses its transparency and polished surface, its various portions, such as those reflected upon the valves, become thickened with a cretaceous or osseous matter deposited between its laminæ—and the morbid changes of the pericardium are precisely similar.

Though either of the serous membranes of the heart may be the seat of arthritic inflammation, and though we may not be able to detect during life the precise portion of the membrane which is inflamed, on examining the hearts of those who had long suffered from gout, the morbid products are in most instances met with in the endocardium, and chiefly in that portion of it which lines the systemic heart.

The changes which take place in the pericardium, and in the endocardium, from gouty inflammation, not only resemble those produced by common or idiopathic inflammation, but there are also changes which may be deemed pathognomonic of gout.

Deposit of a cretaceous matter.

Of these the most characteristic is the deposit of an *earthy* or *cretaceous-looking matter*, of various degrees of consistence, in the tissue which has been the seat of arthritic inflammation ; and likewise in the separation of a similar matter from the blood by the different excrementitious organs.

In the joints and bursæ,

The deposit of a cretaceous matter in the joints and bursæ has always been considered to be the effect of gout. Whenever the arthritic inflammation of a *bursa* advances so far as to create ulceration of the superincumbent skin,—a process which not unfrequently takes place, to permit the escape of a "chalk-stone," —a fluid containing the same opaque white matter will often be long afterwards secreted, and exude from a fistulous orifice in the integuments.

and in the Meibomian glands,

A similar chalky deposit, I have observed in the *Meibomian glands;* the palpebral conjunctiva being one of those mucous membranes which is by no means unfrequently affected with arthritic inflammation. I have likewise seen the surface of an *ulcer of the cornea*, the effect of an arthritic ophthalmia, covered with an opaque white cretaceous matter.

and upon an ulcer of the cornea,

and expectorated from the lungs, kidneys, and skin.

Chalk-stones are frequently coughed up from the *lungs;* a cretaceous matter is often discharged from the *kidneys;* and there are instances in medical records where a similar matter has been excreted by the *skin.*

"A patient who suffered for several months from a paroxysm of gout, had the entire surface of the body covered every morning with a white powder, as if it had been dusted with flour."

Swideaur.

"Pechlin saw several young men, apparently of the most robust and best habits of body, sweat a kind of 'tophaceous' matter. One of them died before he was forty years of age; and such was the general tendency of his humours to a chalky nature, that whatever he spat or sweated was rendered white, from the abundance of this gypsius matter."

Van Swieten.

Clark considers "white ropy filaments in the urine, which, when dried, turn to a kind of calx," as a diagnostic sign of gout.

A cretaceous deposit pathognomonic of gout.

From these morbid phenomena it therefore appears to me, that the excretion of a cretaceous matter may be considered as a pathognomonic character of gout; and that the "chalky" or "earthy" deposits so frequently met with in the membranes of the heart may be legitimately considered as the produce of arthritic inflammation.

Chemical qualities of the cretaceous deposit.

In endeavouring to show the analogy of gouty inflammation of the heart to that of other organs affected with gout, I have made use of the common terms of calcareous, cretaceous, and earthy matter; but it is proper to observe, that recent analysis has shown that some of these concretions consist of the *urate of soda*, and others of the *phosphate of lime.*

Urate of soda is also found in the *venous blood* taken from the arm of gouty persons,—an important fact, which not only shows that the excretion of that saline substance may be legitimately considered as a pathognomonic character of gout; but it also

Garrod.

affords incontrovertible evidence of gout being the effect of its presence in the blood, or of a vitiated state of the vital fluid.

The metastasis of gout.

There is no more striking phenomenon connected with the history of gout than its susceptibility of being *translated* from one organ to another—an important fact to be kept in mind in the treatment of that disease.

Translated from the heart.

Gout may either be translated from the heart to the extremities, or from the extremities to the heart. When the heart is suffering from gout, it frequently happens that the symptoms are immediately relieved by the gout being translated to the feet; this may be considered, along with other symptoms, an unerring diagnostic sign of the arthritic nature of the disease of the heart.

Cases.

A barrister complained of an uneasy feeling in the region of the heart, and of occasional palpitations during nine years. Pain and redness now affected first the little toe of one foot, and the inner ankle of the other foot; on the following day, all the uneasy feelings in the chest abated. I saw him six weeks afterwards with tenderness remaining in one foot, all the unnatural feelings in the chest relieved, and a great amendment had taken place in his general health.

Baillie mentions having seen a person who had suffered from palpitation of the heart for six months, which suddenly disappeared on the accession of a fit of gout; Scudamore relates a similar case.

Treatise on Gout, &c.

"There are two cases of a *translated gout;* the one of which is an affection of the neck of the *bladder*, producing pain, stranguary, and a *catarrhus vesicæ;* the other is an affection of the *rectum*, sometimes by pain alone in the part, and sometimes by hæmorrhoidal swellings there. In gouty persons, I have known such affections alternate with inflammatory affections of the joints; but whether to refer these affections to the retrocedent or to the misplaced gout, I will not presume to determine."

Cullen, vol. i. p. 291.

When the local articular inflammation is checked, or altogether ceases, symptoms supervene which point out that the disease has been translated to the heart, or to some other internal organ.

Translated to the heart.

Numerous are the instances of persons, who, when suffering from gout in the feet, by plunging them into cold water, the gouty inflammation of the joint suddenly ceased, and was translated to the heart.

Case of George IV.

The circumstances which attended the last illness of George IV., furnish a very distinct history of the more striking features of a gouty affection of the extremities being translated to the heart. An account of this case cannot fail to be generally interesting, more especially as no correct statement of His Majesty's last illness has been given by any of his medical attendants; whilst it also affords me an opportunity, even at this distant period, of correcting some erroneous statements made for unworthy purposes.[1]

I have formerly alluded to our Royal Family, as an example of the hereditary nature of gout; many of them having perished from gouty affections of the chest.

George IV. often suffered from gout; luxurious habits of life also rendered the general system plethoric, and very susceptible of inflammatory attacks, the inflammation usually affecting the chest.

To relieve the pain attending the paroxysms of gout, the King had, amongst a variety of other remedies, frequently taken "Wilson's Gout Tincture," and the inflammatory attacks of the chest had often required for their relief copious blood-lettings. His Majesty also had, during many years, often complained of uneasy feelings in the head, which were always relieved by cupping.

The last illness of George IV. may be said to have commenced in the spring of 1830; the king had then a severe attack of inflammation, from which he never altogether rallied.

In the beginning of April, His Majesty, as well as those around him, became extremely anxious about his condition, and on Saturday, the 23d of April, the King sent Lord Strathaven, his equerry, to London, with a message to me commanding my attendance at Windsor on the following morning.

Not having seen the King for some weeks, I was much struck on entering the bed-chamber, by the change in the expression of His Majesty's countenance, which bespoke great anxiety.

The king was sitting up in bed, unable to recline in a horizontal posture; breathing with great difficulty; and with an oppressed and intermitting pulse. All the pained gouty feelings which were in the joints had, for some time, subsided, but the difficulty of breathing returned.

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[1] *Essays and Orations*, read and delivered at the Royal College of Physicians, &c., &c., &c., by Sir Henry Halford, 1831.

After a lengthened conversation, in which the King gave a most lucid and detailed account of the progress and symptoms of his malady, "I wish that you, my good friend," observed the King, "would tell me candidly your opinion of my condition, —I can get no satisfactory answers from Sir Henry Halford."

My reply was, "It appears to me, Sire, that the character of your ailments has lately changed, and that, instead of any important disorder being now present in the lungs, the great embarrassment in the breathing arises from a disturbance of the heart, and that this disturbance of the circulation is caused by the gout having left the extremities, and having been translated to the heart." On pressing for an opinion on the danger of the disease, which the king did in a firm, manly tone, I replied, "Your Majesty must be quite aware that, when a vital organ is affected, it is impossible to say that there is *no* danger, but I am convinced, from the nature of your present condition, much relief may be obtained by medical treatment."

After explaining to the King the proposed mode of treatment, I retired.

Sir William Knighton afterwards requested me to *write* my opinion, both of the nature of the disease with which the King was afflicted, and of the remedies I proposed, in order to be put into the hands of Sir Henry Halford, who was expected at Windsor in the evening. The following is a copy of my letter to Halford:—

"DEAR SIR HENRY,—"The reason of my now writing to you, I will explain on our first meeting.

"It appears to me that the distressing dyspnœa, of which the King complains, arises from a *disease of the heart;* and I believe that the affection of that viscus depends upon an arthritic diathesis.

"I cannot help being impressed with the opinion, that if the gout would affect the extremities, the heart would be relieved, and, with this view, benefit might be derived by the use of the pediluvium and stimulants to the legs and feet. Though general depletion be inadmissible, I would expect benefit from the application of six or eight leeches to the region of the heart, and these to be repeated according to the effects produced.—Believe me yours faithfully,

"JAMES WARDROP.

"WINDSOR CASTLE, *April* 25, 1830."[1]

To this letter I received no answer, nor was I afterwards consulted.

The King expired on the 26th of June, and the morbid appearances, which were *officially* published, fully confirmed the opinion I had given of the nature of the King's illness.

"Two pints of water were found in the cavity of the right side, and three pints and three-quarters in the left side of the chest. The left lung was considerably diminished.

"The lower edge of each lobe of the lungs had a remarkable fringe, which, upon examination, was found to be formed by a deposit of fat.

"The substance of the lungs had undergone no change of structure; but the mucous membrane lining the air-tubes was of a dark colour, in consequence of its vessels being turgid with blood.

"The pericardium contained about half an ounce of fluid, but its opposite surfaces in several parts adhered to each other from inflammation at some remote period.

"Upon the *surface of the heart and pericardium*, there was *a large quantity of fat;* and the muscular substance of the heart was so tender as to be lacerated by the slightest force. It was much larger than natural. Its cavities upon the right side presented no unusual appearance; but those on the left side were much dilated, more especially the auricle.

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[1] "In the case of his late Majesty, the King's Government and the Royal Family were apprised as early as *the 27th of April* (I hold in my hand the original letters which gave the information to the Prime Minister), that His Majesty's disease was seated in his chest, and that an effusion of water into the chest was soon to be expected. It was not, however, *until the latter end of May*, when His Majesty was so discouraged by repeated attacks in the embarrassment in his breathing, as to desire me to explain to him the nature of his complaint, and to give him my candid opinion of its probable termination, that the opportunity occurred of acknowledging the extent of my fears for his safety."—*Orations, &c.*, p. 67.

"The three semilunar valves at the beginning of the aorta were ossified throughout their substance, and the inner coat of that blood-vessel presented an irregular surface, and was in many parts ossified."

Gout translated to other internal organs.

When alluding to the *metastasis* of gout, it ought, however, to be mentioned, that on leaving a joint it is not always translated to the heart, but sometimes to some other organ, especially to the stomach, to the head, or to some portion of the gastro-pulmonary mucous surface.

Its metastasis caused by an injury;

The translation of gout is likewise the consequence of a distant part being injured, or of a surgical operation. When a gouty person receives an *injury*, such as spraining a joint, I have frequently seen instances where the subsequent inflammation has been completely subdued by local bleedings and other depletive means; but soon afterwards inflammation attacked the injured part, the rose-colour of the skin, the accompanying œdema, the hereditary gouty disposition, and the inefficacy of the system of treatment previously adopted, pointed out the attack to be of an arthritic character.

(Case)

A lady sprained her wrist severely; the subsequent inflammation required the repeated application of leeches before it was subdued. About six weeks after the accident, and when only a slight tenderness and swelling remained, the wrist, back of the hand, and a part of the fore-arm, suddenly became much swollen, the skin of a bright pink colour, with considerable tenderness. Suspecting, from the inefficacy of the former remedies, as well as from the local and general symptoms, that this inflammation was of an arthritic character, I treated it accordingly; all the symptoms speedily yielding to a few small doses of colchicum, combined with the carbonate and sulphate of magnesia.

or by a surgical operation;

The propriety of weighing the necessity of any surgical operation on a gouty subject, and of his being in a fit condition before it is performed, is of essential importance to its success; as it has frequently happened that operations have failed from the wound being attacked with gout. This, I am convinced, has often been the cause of the want of success in lithotomy, and in the operations for the cure of cataract; both urinary calculus and cataract being diseases common in gouty persons.

(Case of George IV.)

The operation of removing a steatomatous tumour from the head of George IV., nearly proved fatal, gout having been translated from his knee-joint to the wound a few hours after the operation. But when the gout attacked the foot, a few days afterwards, the arthritic inflammation left the head.

or by medicines.

Effects in many respects analogous to those just mentioned are produced by *medicinal substances*, such as colchicum, which, after quickly subduing the pain and local inflammation of a severe attack of articular gout, the inflammation soon returns, and often in another and a vital organ. The dangerous effect of such medicines may be, to a certain extent, avoided by combining them with those which increase the excrementitious processes of the skin, of the kidneys, and of the alimentary canal.

Case.

A naval officer received an invitation to dine at the Pavilion; having been seized with gout in his feet, he sent for a physician, requesting him to employ such remedies as would enable him to dine the following day with the King. Accordingly, a dose of *colchicum* was administered, which speedily gave relief, and enabled the gallant admiral to go to the royal feast! In a few days afterwards he consulted me on a great difficulty of breathing, accompanied by tenderness in the cardiac region. The pulse was so rapid and unequal that it could with difficulty be counted, leaving no doubt of the arthritic character of the attack, in consequence of the gout having been translated to the heart from the extremities. Though the more severe symptoms of the attack were subdued by antimony, opium, and mercury combined, along with "derivatives," yet his health was never restored, and he died three years afterwards of a diseased heart.

Hereditary character of gout.

The *hereditary* nature of gout has long been the theme of much comment and dispute; but it may be said of gout as of scrofula and cancer, that there are families who are more subject to it than other families; although there are no individuals of whom it can be asserted, that they may not have an attack of gout. Many persons, but especially women, dislike the notion of having a complaint which has any relation to gout, from an erroneous impression, that gout is a disease incident only to the votaries of Bacchus and Venus. Though gout, like most other ailments, is aggravated by habits of sensual indulgence, yet it may be frequently observed in those who live very temperately, and who are not able to trace it to any hereditary taint. Indeed we may often notice in the same family that different branches suffer in various degrees from this malady; some being severely afflicted, some more slightly; and others passing through a long life without having had even the most trifling illness of a gouty character.

Symptoms and Diagnosis.

That during the very earliest stage of a gouty affection of the heart *inflammation* must be present, we may venture to conclude, from the accompanying symptoms, though we cannot expect that so slight a degree of inflammation as would materially disturb the heart should be manifest after death, more than would inflammation in a portion of skin or of mucous membrane, should be visible after death, though quite apparent during life.

When gout assumes a paroxysmal type, either the heart continues to be the chief seat of the local inflammation, or, far more frequently, the inflammation affects at the same time one or several of the synovial capsules.

If the inflammatory attack be confined to the central organ, then, together with all the symptoms of general fever, there is superadded a tumultuous action of the heart. The *impulse* and *rhythm* are changed, the heart palpitates more or less violently, the beats are increased in frequency, and they and the arterial pulse are often irregular and intermitting.

The *sounds* are also changed according to the severity of the attack and the portion of the endocardium which is affected.

Changes in the lungs.

The irritable condition of the heart explains the disordered state of the *cerebro-spinal* and *pulmonary* systems which accompanies it; for, whenever the action of the heart is changed, the alterations in the circulation necessarily produced in the lungs and in the head, disturb the functions both of the pulmonary and of the nervous systems. When the inflammation of the heart is of a more acute character, the brain and the lungs then become still more disordered; the restlessness, irritable state of mind, and oppression in breathing, are all increased.

In those examples of gout, where the disease has been suddenly translated from the extremities to the head, causing *apoplexy;* or to the chest, producing difficult respiration and *asthma*, it is extremely probable that future observers will find that such effects have arisen from gout being translated to the heart; whose disordered functions produce changes both in the brain and in the lungs.[1]

Apoplexia arthritica.

In the multiplied observations on apoplexy, where particular cases are narrated which were considered to be caused by gout, no allusion is made by any writer, nor has any one attempted to trace the symptoms of the disordered brain to a disease of the heart; though in several instances the morbid condition of the heart has been distinctly mentioned. The case of the celebrated anatomist, Malphigi, is one of those of "arthritic apoplexy" wherein the heart was diseased, gouty concretions being found in the brain, and likewise "ossification in the valves of the heart."

Portal, *Traité l'Apoplexie.*

Changes in the cerebro-spinal system.

The disorder in the heart's functions explains satisfactorily how, from the changes in the circulation of the cerebro-spinal system, mental irritability and restlessness should be so constantly present in gouty affections of the heart. These effects of a disordered circulation might, indeed, be referred to, in order to illustrate the influence of changes in the action of the heart on the nervous system; they afford additional proof of those pathological views I have, in a former part of this work, endeavoured to establish. The effects of a disordered circulation likewise afford an additional proof of the errors of those nosologists who have classed them amongst *nervous* diseases, conceiving them to be primary affections of the nervous system.

The heart is affected with gout in various degrees.

In gouty persons the heart appears to suffer in all possible degrees. In some instances this organ is severely affected; in the majority of cases it is only after repeated paroxysms, and after the lapse of many years, that permanent changes have been found in the heart's structure sufficient to interrupt the stream of blood. Dissection reveals to what a remarkable extent the auriculo-ventricular orifices may be contracted from repeated attacks of arthritic inflammation, and how life has often been long preserved by habits of great moral and bodily tranquillity, even after the structure of the circulating apparatus has been materially impaired, and the body supplied with only a very small stream of oxygenated blood. Unless the circulation be disturbed from any accidental cause, and thus life instantly destroyed, those suffering from arthritic inflammation of the heart usually perish from the effusion of water in the cavities of the pericardium, and the pleura, and in the cellular tissue.

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[1] "The same observations may be made with respect to many instances of *hysteric* paroxysms; and the circumstance both of epileptic and hysteric paroxysms, ending in coma, or a degree of apoplexy, leads me to think, that also the apoplexy, proceeding from retrocedent or atonic *gout* is of the same kind, or that it depends upon an immobility of the nervous power, rather than upon compression."—Cullen's *Mat. Med.*

During a prolonged paroxysm of gout, it frequently happens that the joints and the heart suffer alternately. When the joints become inflamed, whatever disturbance may have previously been in the heart's condition, the cardiac symptoms are now alleviated, or altogether subside.[1]

Heart alone affected.

Besides those who have been sufferers from gout in the extremities, and in whom there is no doubt of the connexion of the gouty attacks with a disturbed condition of the heart, there are many, chiefly women, in whom gouty inflammation appears to be limited to the heart. Indeed, so large has been the proportion of instances of this description that have come under my own observation, occurring more especially at that period of woman's life when the menstrual flux is about to cease, that arthritic carditis may be considered as a frequent complaint; though, from the symptoms accompanying it, such affections have been generally arranged amongst *nervous* diseases.

In women especially.

Though it has commonly been considered that gout is much less frequent in women than in men, this remark strictly applies only to articular gout, or to the more severe gouty paroxysms, wherein the joints are violently inflamed. The frequency of arthritic affections of the heart in women may be accounted for by the well-known fact in the history of gout,—that any gouty affection of an internal organ is relieved by a paroxysm of articular inflammation; and as men are far more subject to articular gout, consequently, in equal numbers of gouty men and women, a proportionably smaller number of women are affected with articular gout; and a greater proportion of women will be found with a disturbed heart than men.

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[1] "Whether the *gouty diathesis* does ever produce such inflammation of the internal parts, without having first produced it in the joints, or if the inflammation of the internal parts be always a translation from the joints previously affected, I dare not determine; but, even supposing the latter to be always the case, I think the difference of the affection of the internal parts must still distinguish the misplaced from what I have named the retrocedent gout.

"What internal parts may be affected by the misplaced gout, I cannot precisely say, because I have never met with any cases of the misplaced gout in my practice; and I find no cases of it distinctly marked by practical writers, except that of pneumonic inflammation."—Cullen, vol. i. p. 291.

The gouty affection of the heart does not necessarily come on either from any violent exertion, or from any violent mental emotion; causes to which other affections of the heart can usually be traced.

As might be supposed, gouty affections of the heart, from their specific character, arise not only from the translation of gout from one part to another, such as from the toes or feet to the heart; but this affection of the heart may be preceded by those derangements of the digestive functions which accompany attacks of gout in other organs.

Symptoms arising from a disordered state of the incrementitious or excrementitious processes, either accompany or precede the local gouty inflammation. Such symptoms may precede the accession of any local inflammatory paroxysm only a short time, or they may be present alone for many months, or even years, previous to any local inflammatory paroxysm. There are many instances, especially amongst women, where a disordered state of the sanguiferous, as well as of the digestive system, had existed for a long period, without any local inflammation, sufficiently characteristic to establish the arthritic nature of the malady, having made its appearance; though doubtless, in such cases, there must have been present an increased vascularity of some portion of one of the serous tissues of the heart, as well as a change in the qualities of the blood.

Gouty dyspepsia.

The condition of the *digestive organs* gives rise to an important class of symptoms in arthritic affections of the heart. The deranged state of the stomach which so universally precedes an attack of gout, and which is so remarkable during the progress of the premonitory symptoms, wherever the local inflammation may be situated, led to the common observation of "gout being generated in the stomach."

There are no symptoms more characteristic of gouty *dyspepsia* than *acidity* and *flatulency*; the alvine evacuations are generally irregular, and their quantity and qualities unnatural. The appetite is either impaired, or there is a morbid desire for food, and often for aliments which are disliked during health. Sometimes there is pain in the precordial region, and not unfrequently a sensation of nausea, and sometimes vomiting.

Changes in the tongue.

There are appearances on the *tongue* which will be found very characteristic of gouty dyspepsia. Both its bulk and its form are changed. Sometimes it becomes so large as to receive an impression of the teeth of the lower jaw, and instead of being convex it assumes a concave form. The peculiar changes in the *colour* of the tongue's surface are equally characteristic; the edges become of a dull white or slate hue, whilst the central portion is usually covered with a dark brown fur.

A remarkable circumstance in the history of gout, and of which I am not aware that there is any analogy in other diseases, is that, in a person who has been long suffering from all the symptoms of a gouty stomach, if a healthy condition of the digestive organs be restored, a local arthritic inflammation will then supervene; so well known is this, that when talking of the sick, it is a common remark, "that he has not strength to bring out the gout."

Case.

An eminent artist, advanced in years, had long suffered from gouty dyspepsia, and also complained of uneasy feelings in the urinary bladder, all which symptoms I was led to believe were of an arthritic character. When prescribing antimony and mercury combined, and the sulphate and carbonate of magnesia, I made accidentally the observation, that if he could only have an attack of articular gout, all the present symptoms would be subdued. Much to his surprise, in a very few days, for the first time in his life, he had a slight attack of gout in the great toe of one foot; after which his former ailments were completely relieved.

Changes in the biliary organs,

The *biliary organs* are generally much deranged in gouty dyspepsia, as well as the stomach itself,—the bile becoming of an unhealthy quality, and often diminishing in quantity: changes which are marked by the appearances of the alvine discharge, and the discoloration of the skin.

and in the portal system.

Besides the changes in the biliary secretion, there is in many of those who have suffered from repeated attacks of the gout, a congested state of the *portal system*, indicated by a disposition to hæmorrhoids. The connexion of the *hæmorrhoidal flux* with gout attracted the notice of the early writers; and the relief obtained by the spontaneous evacuation of blood in arthritic affections, pointed out the propriety of artificial blood-letting in the treatment of the disease. The repeated and large quantities of blood which are in some cases thus lost, and the relief obtained especially of many symptoms considered to indicate a debilitated system, and likewise many of a nervous character, show how even under such circumstances a depletive system of treatment may be adopted.

Changes in the urine;

The *urine* is much changed in gouty subjects. Those who have suffered from gout are aware of an inflammatory attack approaching when the urine becomes darker and acquires a colour often compared to that of English brandy. It usually deposits a thick "lateritious sediment," and is found to contain *urate of soda*, as well as *phosphate of lime:* the urate of soda varies in quantity before and after the gouty paroxysm. Phosphate of lime is also found in those concretions which are formed in the kidneys, as well as in the coats of the arterial system; but this earthy salt has not been detected either in the joints or in the blood of gouty subjects. It is a curious physiological fact, that phosphate of lime and urate of soda are both excreted from the kidneys and coats of arteries, but have not been found present in the blood, and that only urate of soda is excreted by the synovial membranes, and found in the venous blood.

Wollaston's analysis of.

In a therapeutic point of view, it is important to recollect that the proportion of uric acid and phosphate of lime which is contained in gouty urine depends greatly on the food. The quantity of these substances in the blood is increased or diminished according to the quantity of animal food which is consumed—a circumstance that satisfactorily explains how gout is scarcely known in those who live chiefly on vegetable food.

(Magendie)

and in the skin;

I have already had occasion to remark, that the same saline matter, the urate of soda, was in some gouty people excreted by the *skin;* and I have also alluded to persons subject to gout, in whom, by increasing the cutaneous excretion by exercise, the gouty paroxysm, and all the more severe effects of gout, were warded off. Hence the excretion of the urate of soda by the skin, besides illustrating an important phenomenon, also points out how those medicines, which are employed for the relief of gout, and which act upon the skin, separate and evacuate its noxious ingredients, and relieve the symptoms.

and in the pulmonary exhalation.

The earthy deposits in the *lungs* of gouty persons also show, how the pulmonary exhalation is contaminated and becomes a channel for the excretion of vitiated elements from the blood.

Influence of the sanguineous system.

The condition of the sanguiferous system will always be found to have an important influence in gout, producing symptoms, some of which are referable to the vitiated qualities of the blood, and others to the state of the heart itself.

When speaking of the disorders of the heart caused by changes in the blood, I briefly alluded to those diseases in which the natural constituents of the *blood* were altered in their proportions, and also to those changes which arise from the re-absorption of secreted fluids into the blood. But there are also changes in the blood which are caused by the addition of new elements; of which the most striking example, which analysis has yet obtained, is the presence of *urate of soda* in the *venous* blood of gouty people.

Urate of soda in gouty venous blood.

There can be no more satisfactory evidence of this earthy deposit being a pathognomonic symptom of gouty inflammation, than that urate of soda is always found in gouty venous blood; whilst the fact of this salt being detected in the blood, likewise shows the important share which the blood must have in the production of gout.

From the morbid changes, both in the process of incretion and excretion, which precede and accompany gout, we might have anticipated, that there must be some important changes in the qualities of the blood. Although gouty blood has been found to contain the urate of soda, only the *venous* blood has yet been analysed, and blood taken only from the veins of the arm, so that we are still ignorant of the nature of the venous blood in different organs, and also of any noxious ingredients of the *arterial* blood.

The arterial gouty blood not yet analysed.

A knowledge of the vitiated elements which may be present in the arterial blood, might perhaps lead to some rational principle for the treatment of gout, and also to a satisfactory explanation of the effects produced by those remedies which are considered to be the most beneficial in its treatment. Pursuing, however, our inquiries upon this interesting subject, the chemist should not be satisfied with finding in the blood urate of soda; as it is extremely probable, that as *phosphate of lime* has also been detected in gouty concretions formed in the joints, in the kidneys, in the coats of the arteries, and in those membranes subject to gouty inflammation, that the same earthy matter, as well as other noxious elements, may in all probability be also found in the blood.

Gouty blood disturbs the heart.

Admitting that the blood in gout is vitiated, it is then legitimate to infer, that such blood circulating through the heart will be sufficient to account for those disturbances of the circulation which precede and accompany an arthritic paroxysm,—a condition of the heart which varies in every possible degree. As a general remark, it may be said, that whenever the presence of gout can be distinctly traced in any individual, there is either always preceding, or along with, the disease in the joints, some disturbance in the heart.

Gout combined with other diseases.

Inquiring into the phenomena of gout, whatever may be the organ affected by it, it is essential to discriminate the symptoms which are strictly of an arthritic character from those which are produced by other diseases with which gout may be combined—especially with plethora and rheumatism.

With plethora.

It is the combination of gout with *plethora* which constitutes the gouty paroxysm, and in which may be perceived, in addition to all the arthritic symptoms, both general and local, symptoms also of idiopathic inflammation.

This combination is precisely what may be observed in other specific diseases, such as scrofula, syphilis, and cancer; the organs or tissues affected by these diseases being frequently attacked at the same time with an idiopathic inflammation. Thus a scirrhous tumour of the mamma is often accompanied by extensive inflammation and swelling of the cellular membrane surrounding the mammary gland: this inflammation can be relieved by bleeding and other local means, whilst the scirrhous nucleus remains unchanged. So also a contaminated lymphatic gland in the vicinity of a syphilitic ulcer often becomes inflamed from some accidental cause; the idiopathic, or common inflammation thus superadded, yielding to local depletion, whilst the venereal poison can only be afterwards destroyed by mercury. Now, it is precisely the same with gout; the inflammation caused by a blow or other injury upon a gouty joint, is relieved by the local abstraction of blood, whilst the arthritic inflammation requires a very different system of treatment.

Neither is it unusual to find gout combined with *muscular rheumatism;* in such cases, the character of the two diseases is so different from each other, that they can frequently even be distinguished by the sufferer,—sometimes describing his ailment as being arthritic, and at other times as rheumatic.

Gout and rheumatism combined.

It is no less essential to distinguish the arthritic from the rheumatic symptoms in those cases where gout is combined with the *articular rheumatism;* in rheumatism that affects the joints this combination may be frequently observed.

Articular rheumatism and gout are perfectly distinct diseases, differing in some most essential characters. There is no feature in their history that has so much contributed to give an impression of their similarity, and of their not being easily distinguishable from each other, as the fact of their being so often combined in the same person.

Diagnosis of gout and rheumatism.

The circumstance of gout and articular rheumatism being frequently combined in the same person, and that some of the symptoms are similar, causes them to be frequently confounded with each other—gout is mistaken for rheumatism, and rheumatism for gout. There are, however, diagnostic characters which will seldom fail to determine the true nature of each.

Gout has been shown to be the consequence of a long-continued imperfection both in the incrementitious and in the excrementitious processes, by which the blood is contaminated, and the sanguiferous system becomes sooner or later deranged. But articular rheumatism is usually caused by external agents, especially by changes in the atmosphere, the exposure of the cutaneous surface to a cold and moist air; and it also attacks persons apparently in good health.

The condition of the blood in the two diseases is essentially different; the *urate of soda*, which is present in gouty venous blood, is not found in the blood of those suffering from rheumatism; their blood being remarkable for a large proportion of *fibrine.*

Articular rheumatism usually commences in an acute form, and passes into the chronic stage; whilst the phenomena of gout are at first passive, and afterwards assume an acute character.

Muscular and *neuralgic* rheumatism are as equally distinct from articular rheumatism, as gout is. What can be more dissimilar than the pain which suddenly affects a muscle when it has been exposed to cold, and a joint attacked with gout? In neuralgic rheumatism, the character of the pain, and its seat in a nerve, are unlike the phenomena of gout.

Treatment.

General observations.

The general principles to be employed in the treatment of arthritic affections of the heart are precisely the same as those which are most applicable to the treatment of gout in whatever organ the inflammatory attack may appear; all the different species into which nosologists have subdivided gout being, as I have said, merely phases of one specific disease.

As the premonitory symptoms of gout, especially those of the heart, are generally slow in their progress, and often of long duration before there is any severe inflammatory paroxysm, the treatment of these symptoms becomes of the greatest importance; not only in order to avert an attack of acute arthritic inflammation, but to prevent any permanent changes taking place in the heart's tissues.

The curative indications in gout.

To correct the vitiated condition of the *blood* is a most essential curative indication in gout; and it is not only necessary to discharge from the blood its noxious elements, but likewise to improve the qualities of the incretions.

The remedies which improve the excretions.

In the first class of medicinal substances are those which separate and discharge from the blood its excrementitious matters, either by their action on the digestive canal, on the pulmonary and cutaneous surface, or upon the kidneys.

Mercury and antimony.

Of the medicines that act upon the digestive canal, the most powerful are *mercury* and *antimony*. The preparations of mercury and antimony, given singly or combined, have a great effect in evacuating from the alimentary canal morbid secretions, as well as having an influence on the biliary organs.

"Antimony and calomel are both remarkable for promoting mucous discharges, the one as an emetic, and the other as a purgative; and there is a great analogy between their respective operations. What antimony is to the stomach, calomel is to the intestines; and the resemblance is still closer, for calomel is capable of acting on the stomach and of exciting vomiting, and antimony frequently acts as a purgative; both, too, produce ptyalism. We, therefore, can supply by the one that property in which the other is deficient, and, in the combination of both, we have a means of evacuating the whole alimentary canal." Barlow.

One grain of *calomel*, with a third of a grain of *tartarized antimony*, or with a couple of grains of the antimonial, or of James's Powder, may be given once or twice a day, according to the severity of the symptoms, and the beneficial effects produced. The calomel ought to be carefully exhibited, taking care that the organs of circulation are not disturbed by its influence on the blood.

The antimonial, or the James's Powder, taken singly, has a powerful effect in tranquillizing the heart; five grains of either of them may be taken at bedtime, or a smaller dose may be repeated two or three times a day.

Of vomiting.

In some conditions of the stomach, great benefit is derived from antimony when it causes *vomiting;* when the tongue is much discoloured and loaded, and that there is a disposition to nausea, vomiting sometimes produces the best effects, not only by evacuating morbid secretions or undigested food from the stomach, but by the powerful influence which the act of vomiting has in restoring the balance of the thoracic circulation.

Whilst it is advisable not only to regulate the bowels, but also to evacuate any morbid secretions which they may contain, "it is at the same time proper that the medicines employed should be such as may keep the bowels regular without much purging." Cullen. However, it is surprising to find that in some instances, where purgatives had been previously given even to a great extent, the alimentary canal still remains loaded with excrementitious matters.

Sudorifics.

The influence of *sweating* in relieving as well as preventing gout is remarkable. That some unhealthy ingredient is by this excrementitious process discharged from the blood appears probable; a cretaceous-looking matter being contained in the cutaneous exhalation of gouty people.

Cases have already been mentioned of gouty persons, who never failed to ward off a paroxysm of gout by taking such exercise and clothing themselves in such a manner as would produce a copious perspiration. On this principle may be explained the great value which has been placed on exercise, and "the remarkable and almost incredible relief obtained by riding on horseback in most chronic diseases. For this kind of exercise strengthens all the digestive powers, whilst it revives the natural heat by the continual motion of the body, and enables the secretory vessels to perform their functions of purifying the blood in a proper manner."—"Exercise, unless it be used daily, will do no service; for if it be interrupted at times, it will avail little in changing the constitution."

Sydenham.

Of equal value are *sudorifics;* those medicines which have the reputation of curing gout, such as *colchicum*, seldom produce their good effects without causing a more or less copious perspiration. Hence the benefit of the *warm bath*, of *fomentations*, and of *poultices* to the inflamed parts.

Diuretics.

Besides those remedial means which discharge by the alimentary canal and by the skin excrementitious matters from the blood, the kidneys are likewise an important outlet, more especially in the more advanced cases of gout, where a sero-albuminous fluid is collected in the serous capsule of the heart, and is infiltrated throughout the cellular tissue.

Squills, *digitalis*, *mercury*, and the *alkalis* administered singly or combined with *opium* are most useful diuretics, and are to be exhibited according to the general rules that have been already pointed out.

The dropsy of the pericardium and anasarca.

Anasarca relieved by a natural process.

When gouty inflammation has repeatedly affected the heart, there is often an accumulation of serum, both in the pericardium and also in the cellular tissue, which may be remedied. But if the effused fluid cannot be removed by diuretics and absorbents, it is then advisable to discharge it by an artificial opening in the skin. If it be collected to so great an extent as to create not only an alarming oppression in breathing, but to distend the skin of the lower limbs, Nature wisely commences a process of ulceration, and ultimately a slough of the integument separates, leaving an opening through which the fluid infiltrated in the cellular tissue oozes, and sometimes in such a quantity as to relieve all the symptoms, particularly the oppressed breathing.

This process may be imitated.

This process, employed by the economy to relieve the system of a morbid collection of sero-albuminous fluid, may be advantageously imitated by making punctures in the distended skin, through which the fluid may escape. This simple operation has not usually been resorted to, until a far advanced state of the disease, for the wounds, when made with the common lancet, are not only difficult to heal, but often the surrounding skin sphacelates, and causes an incurable ulcer. Now all the evil effects of a wound made with a lancet are avoided, by making a *puncture* either with a round needle, or with the "glover's needle," which is triangular. Not only does the water flow more freely from the puncture than from the small incision of a lancet, but it is less apt to close; and it is seldom followed by sphacelation and ulceration. From the advantages of this mode of puncturing the integument of an anasarcous limb, this palliative remedy should be unhesitatingly adopted, whenever the integuments are so over-distended as to become a source of considerable uneasiness, instead of postponing it from a notion that by further delay any advantage can be obtained.

By acupuncturation.

Expectorants.

From the intimate union of the lungs and heart, not only are the functions of the lungs disturbed in gouty affections of the heart, but the pulmonary mucous membrane is frequently more or less inflamed. It is under such circumstances that expectorants, such as *squills* and *ipecacuanha* may be advantageously administered.

The remedies that improve the incretions.

Another class of medicines which are to be employed in the treatment of gout, are those which improve the *incretions;* whether these may have become unhealthy from unhealthy matters received by the incrementitious organs, or from the imperfect manner in which these organs have performed their functions.

Sydenham.

"Whatever remedies assist nature," observes the great Sydenham, "to perform her functional duty, either by strengthening the stomach so that the aliments may be well digested, or the blood that it may sufficiently assimilate the chyle received into the mass, or the solids, so as to enable them the better to change the juices, designed for their nutrition and growth, into their proper substance; and whatever preserves the secretory vessels and the emunctories in such a state that the excrementitious parts of the whole system may be carried off in due time and order."

The haustus albus of the old pharmacopœias.

Half a drachm of the *carbonate* and two drachms of the *sulphate* of *magnesia*, mixed in peppermint-water, is a most useful combination, and particularly suitable to gouty people, relieving the acidity and flatulency of such frequent and distressing symptoms of gouty dyspepsia. It may be taken in the morning or at bed-time, and continued as long as the tone of the stomach improves by its use. The compound tinctures of *rhubarb* and of *aloes*, and the decoction of aloes, are also well adapted to regulate the bowels, and improve the digestion of the gouty.

Gregory's Mixture.

The condition of the stomach is often much relieved by the exhibition of *magnesia*, *potash*, and *ammonia*, combined with bitters and purgatives. Magnesia, along with rhubarb and ginger, or some aromatic bitter, either in large doses occasionally, or a prolonged course of small doses taken once or twice a day, materially improve the digestive function, and ward off a paroxysm of gout.

Cinchona extolled by Sydenham.

The *cinchona* has long been in repute for improving the tone of a gouty stomach. "Of all simples the Peruvian bark is the best, for a few grains of it taken morning and evening strengthens and enlivens the blood."

Hoffman's tincture of cinchona.

The compound tincture of *cinchona* diluted with lime-water, is another useful formula; the *mineral acids* are in many cases most grateful, and may be taken combined with cinchona.

Mineral waters, their effects.

There are also many of the *mineral waters* that have great repute in improving the digestive organs of gouty persons, and thus enable them to have a paroxysm of articular gout. "I believe it," says the learned Cullen, "to be evident to everybody, that the phenomena of gout have a constant connexion with the state of the stomach, *and particularly that a certain strength of tone in this organ is necessary to produce a paroxysm of inflammatory gout.*"

Dietetics.

Whatever may be the influence of a hereditary predisposition to gout, it is universally acknowledged that the severity of the disease greatly depends on *diet* and habits of life. The difference in its frequency amongst a peasantry who live chiefly on vegetable food, and the working class of a community, who consume a large proportion of animal food, is very remarkable. In the affluent classes of society the same observation is also verified; for though there are individuals amongst them who suffer severely from gout, notwithstanding that their habits of living are abstemious and temperate, yet the generality of persons who have been severely afflicted with this malady are those who have indulged in the luxuries of the table.

"What is a consolation to me," observes Sydenham, "and may be so to other gouty persons of small fortunes and slender means, is, that kings, princes, generals, admirals, philosophers, and divines, and some other great men, have thus lived and died. It may in a more special manner be affirmed of this disease, that it destroys more rich than poor persons, and more wise men than fools; which seems to demonstrate the justice and strict impartiality of Providence, who abundantly supplies those that want some of the conveniences of life with other advantages, and tempers its profusion to others with equal mixture of evils; so that it appears to be universally decreed that no man shall enjoy unmixed happiness or misery, but experience both; and this mixture of good and evil, so adapted to our weakness and perishable condition, is perhaps admirably suited to the present state." Sydenham.

In the treatment of gout, the diet, therefore, is of the greatest importance, that being preferable which contains the smallest proportions of highly azotised food.

Chemical science affords a satisfactory explanation of the effect of diet in the formation of gout; for when carnivorous animals are fed on vegetable food alone, no uric acid is found in the blood,—a fact proved by Magendie: he fed carnivorous animals on food containing little or no *azote*, and their urine became deprived both of uric acid and phosphate of lime.

Malt liquors recommended.

Malt liquors have been highly recommended as a beverage to gouty persons, and "bitter ale" is often to them very palatable and refreshing.

"Gouty persons may drink a large draught of small beer, as, being generally subject to stone in the kidneys, the growth thereof is considerably obstructed by drinking at this time such a liquor, as it cools and cleanses the kidneys." Sydenham.

Wine and spirits generally hurtful.

Wine and spirituous liquors are to be avoided in acute arthritic inflammation, whatever part of the body may be affected; but in the more chronic stages, especially after a severe attack of inflammatory gout, the system becomes so often debilitated, and the digestive functions so much impaired, that, besides bitters, bark, and carminatives, wine or brandy may be advantageously administered.

Case.

The effect of different kinds of wine in gouty persons is remarkable. A gentleman, who was long subject to gout, could produce an attack of articular gout in twenty-four hours by drinking only a single glass of champagne. Such an effect appears contradictory to the singular phenomenon in the history of gout to which I have alluded, that an attack of articular gout may be brought on by *improving* the patient's health.

Besides endeavouring to discharge from the blood its vitiated constituents, and likewise to improve the quality of the incretions, material benefit is derived from changing the qualities of the blood.

Exhibition of hæmatics.

Thus, when there are no febrile symptoms, *hæmatics* may be administered: of these the preparations of *iron* have been long in repute, and, combined with *cinchona*, their *tonic* effects are often increased.

Cullen.

"The most effectual method for strengthening the stomach in gout is iron, which may be employed under various preparations; but, to me, the best appears to be the rust in fine powder, which may be given in large doses."

The *sarsaparilla* infused in *lime-water*, and also the *taraxacum*, are both useful in improving the incrementitious processes.

How a medicinal substance such as *colchicum* may possess, besides its neurotic effects, some element which forms with the blood a new compound, and by which the excrementitious processes of the digestive canal, of the kidneys, and of the skin, are altered, is a problem yet beyond our knowledge of the nature of the processes which are performed in the vital laboratory. Even a successful analysis of gouty arterial blood might lead us into error, were we to expect that by adding to it new elements we should be able to produce new combinations in the blood by which its hurtful properties would be destroyed.

The pathologist must therefore receive chemical analyses with great caution; for whatever combinations or decompositions may be made in the chemical, we must not conclude that similar processes will take place with the same ingredients in the vital laboratory.

Blood-letting to be employed

Besides the means which are applicable to the cure of the specific disease, those remedies are to be employed which will allay the febrile symptoms accompanying the attack of gout. When the constitutional excitement is great, and the local inflammation severe, blood should be abstracted from the arm, and an antiphlogistic treatment rigidly followed, keeping in mind that symptoms will remain,—symptoms characteristic of the specific disease, which cannot be relieved by depletion.

Whenever there is tenderness to the touch, uneasy feelings in the precordial region, oppressed breathing, accompanied with a small wiry pulse, and a strong impulse of the heart, then blood abstracted by a few *leeches*, either from the chest or from the feet, often produces a decided alleviation of the symptoms. The leeches ought to be repeated according to the effects produced, and the severity of the remaining febrile symptoms.

When gout is combined with plethora.

As gout is frequently combined with *plethora*, in the treatment of such cases, not only the means of remedying the vitiated qualities of the blood are to be adopted, but also the propriety of diminishing its quantity. The depletive system, which is so beneficially employed in all other specific diseases, when these are accompanied by plethora, is applicable to the treatment of gout, and especially to the gouty affections of the heart. The use of blood-letting in gout must, as in all other specific diseases, be cautiously adopted; for whilst, on the one hand, the symptoms of plethora are alleviated by the depletion, if carried further it is followed by great debility, the local inflammation assuming a chronic form, which it is difficult to subdue.

The use of blood-letting in gout.

Gout relieved by spontaneous hæmorrhage.

The connexion of the *hæmorrhoidal flux* with gout attracted the notice of the early writers in medicine; and the relief obtained by the spontaneous evacuation of blood in arthritic affections pointed out the propriety of artificial blood-letting, especially the application of leeches to the hæmorrhoidal vessels, in the treatment of certain cases of gout. The repeated and large quantities of blood lost by spontaneous hæmorrhages, and the

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relief obtained by them, in cases where there were symptoms indicating a debilitated state of the system, and also symptoms of a nervous character, show how, even under such circumstances, a local depletion may be advantageously adopted.

In women of a gouty diathesis, who are suffering from inflammatory symptoms of the heart, connected with a disordered state of the uterine system, decided benefit is derived from the application of a few leeches, either on the hæmorrhoidal vessels or upon the feet. I may here remark, that as a congested state of the portal system is indicated by a disposition to hæmorrhoids, the beneficial effects which follow a discharge of blood from the hæmorrhoidal vessels are readily explained.

"From the last considerations, it seems probable, that, during the time of paroxysms of gout, some measures may be taken to moderate the violence of the inflammation and pain; and, particularly, that in the first paroxysms, and in the young and vigorous, blood-letting at the arm may be practised with advantage; but I am persuaded that this practice cannot be repeated often with safety. I believe, however, that bleeding by *leeches on the foot*, and upon the inflamed part, may be practised and repeated with greater safety; and I have known instances of its having been practised with safety to moderate and shorten paroxysms; but how far it may be carried, we have not had experience enough to determine."

Cullen.

The exhibition of neurotics.

During a local inflammatory attack of gout, the *pain* varies exceedingly, according to the part affected, and is much less severe when it is seated in the tissues of the heart, than in the synovial capsules. The neurotics usually given to relieve the pain of gout, are opium, hyoscyamus, belladonna, colchicum, and the hydrocyanic acid. Of these there is no one more to be depended upon to allay pain than *opium;* whilst *digitalis*, *belladonna*, *hyoscyamus*, and the *hydrocyanic acid*, are useful in allaying the irritable action of the heart.

Use of opium.

"*Opiates* give the most certain relief from pain; but, when given in the beginning of gouty paroxysms, they occasion these to return with greater violence. When, however, the paroxysms shall have abated in their violence, but still continue to return, so as to occasion painful and restless nights, opiates may be then given with safety and advantage, especially to persons

Cullen.

advanced in life, and who have been often affected with the disease."

An irritable state of the heart that often remains, after all inflammatory symptoms have subsided, may be relieved by *camphor*, *ammonia*, *galbanum*, the ammoniated tincture of *valerian;* small doses of *colchicum* are also essentially useful.

Neurotics may be applied to the cutaneous surface, as well as taken internally. In the more mild affections of the heart, and where depletive measures have been employed, an embrocation or plaster of *belladonna* may be applied on the nape of the neck.

Use of colchicum.

After the acute inflammatory symptoms have yielded, the *colchicum* has most beneficial effects, diminishing the increased action of the heart, producing copious perspiration, urinary secretion, and alvine evacuations. The good effects of colchicum I have always found to be obtained by small doses. Five drops of the colchicum wine may be taken once or twice a day, according to the severity of the symptoms. It ought always to be given along with the *citrate of ammonia*, or *potash*, or with the *sulphate* and *carbonate of magnesia*, by which combinations the action upon the skin, kidneys, and alimentary canal are rendered more certain; it is when such action does not take place on the excretive organs that the poisonous effects of colchicum are produced. In this respect colchicum resembles *mercury;* for if mercury purges, sweats, or increases the flow of urine, it is discharged from the blood; whereas if none of those effects take place, the mercury is retained in the blood, and becomes a poison to the whole economy.

In administering colchicum, two distinct effects are produced by it; it allays pain, by its action on the sensory nerves, and it forms new compounds with the blood, by which the excrementitious processes of the alimentary canal, the kidneys, and the skin are altered, and the noxious ingredients separated from the vital fluid. Each of these effects must be produced by different elements, of which the colchicum is composed; for, like opium and tobacco, colchicum contains principles which possess perfectly different qualities.

One of these principles of colchicum acts upon the nervous system, and the other, which, like some of the same class of medicinal bodies, contains an element *sui generis*, which is poisonous, and which, if not discharged from the system by the excrementitious processes, vitiates the blood, and has a pernicious effect on certain organs.

The specific remedies for gout.

These remarks on colchicum apply to some other medicines which have been considered to have a *specific* effect in curing gout. *Hellebore*, so much esteemed by the ancients, and the celebrated "Portland Powder," the "Eau Médicinale," and Wilson's "Gout Tincture," whilst they alleviate the pain of gout and subdue the inflammatory symptoms, are all frequently followed by the same pernicious effects on the system as colchicum. That such injurious effects of these medicines are produced by their influence on some particular organs, we may conclude from the numerous cases which are recorded where they are said to have brought on apoplexy, asthma, and dropsy.

Speaking of the baneful effects of the "Portland Powder"—and similar effects I also have often seen caused by colchicum—Cullen observes:—

"One of these (remedies) is what has been named in England the 'Portland Powder.' This is not a new medicine, but is mentioned by Galen, and, with some little variation in its composition, has been mentioned by the writers of almost every age since that time. It appears to have been at times in fashion, and again to have fallen into neglect; and I think that this neglect has been owing to its having been found to be in many instances pernicious.

"In every instance which I have known of its exhibition for the length of time prescribed, the persons who have taken it were indeed afterwards free from any inflammatory affection of the joints, but they were affected with many symptoms of the atonic gout; and all, soon after finishing their course of the medicine, have been attacked with apoplexy, asthma, or dropsy, which proved fatal.

"I have had occasion to know, or to be exactly informed, of the fate of nine or ten persons who had taken this medicine (the Portland Powder) for the time prescribed, which is two years. These persons had been liable for some years before to have a fit of a regular or very painful inflammatory gout, once at least, and frequently twice in the course of a year; but after they had taken the medicine for some time, they were quite free from any fit of inflammatory gout; and particularly when they had completed the course prescribed had never a regular fit, or any inflammation of the extremities for the rest of their life.

"In no instance, however, that I have known, was the health of these persons tolerably entire. Some, after finishing the course of the medicine, became valetudinary in different shapes, and particularly more affected with *dyspeptic*, and what are called *nervous* complaints, and lowness of spirits. In every one of them, before a year had passed after finishing the course of the powders, some hydropic symptoms appeared, which gradually increased in the form of ascites or hydrothorax, especially the latter joined with anasarca; in less than two or at most three years all proved fatal."[1]

Cullen's *Mat. Med.*

Similar effects of other medicinal bodies.

The same phenomena are illustrated by the effects of some medicines in other diseases, especially by the effects of *mercury*. This medicine, as I have before observed, if absorbed into the blood, not only contaminates the sanguiferous system, but often causes diseases in particular organs; and if *iodine* be absorbed into the blood, similar effects on the sanguiferous system, as well as on some particular organs are produced.

Derivatives.

In no disease is the use of *derivatives* of more importance than in the treatment of gout, for in those cases, where a vital organ, such as the heart, is affected by gouty inflammation, we may be able by that class of remedies to translate the gout from the heart to a less important organ.

This principle, for the treatment of gout in the heart, is applicable to those cases where the inflammatory attack has commenced in the heart, as well as to those cases where the arthritic inflammation has left the extremities, and has been translated to the heart.

When the circulation is disturbed from the presence of arthritic inflammation in the heart, besides the local treatment, leeches, applied to the *feet*, have a powerful influence in subduing the inordinate action of the heart, not only by the blood which they remove, but by the local irritation which they frequently create on the skin, and by which the gout is, in some cases, translated from the chest to the feet.

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[1] Many *salutary* processes also occur in the progress of disease which should not be *checked* by the improper administration of medicines. Thus, violent shiverings and tremors of the body, unaccompanied with coldness, and not followed by preternatural heat, occasionally relieve acute gouty pains; but when these are interfered with, metastasis, or a translation of diseased action occurs, and the inflammation, instead of remaining in the toe or instep, may attack the head or the stomach.

Case. A lady, advanced in years, who had repeatedly suffered from gout in the feet, was attacked with an embarrassment in breathing, and a great impulse and disturbance in the action of the heart, which symptoms I attributed to an attack of arthritic inflammation. The application of four leeches to one of her feet caused, on the following day, a good deal of cutaneous irritation; and in three days it was, much to her surprise, succeeded by a regular fit of gout in the great toe; after which the difficulty in respiration, and the disturbance of the heart, were completely relieved.

Case. An officer whose general health was considerably impaired from long services in India, and who had often suffered from articular gout, complained of a difficulty in breathing, tenderness in the region of the heart, and palpitations, with a frequent and irregular pulse. Three leeches were applied to one foot, a dose of James's powder, combined with calomel, was given at bedtime; on the following day he wrote—"The leeches took away a great deal of blood, and as you predicted, the gout is now in my foot, which is much swelled."

To effect a similar purpose the *pediluvium*, with mustard or vinegar, *friction*, *sinapisms* to the feet, *blisters* on the calf of the legs, or *dry cupping* on the soles of the feet, as recommended by Hoffman, may be employed; and even though the gout should not be translated to the extremities, these means will assist in subduing the local affection of the heart.

Case. A gentleman, in the sixty-fifth year of his age, complained of a pain in the region of the heart, dyspnœa, anxiety of countenance, loaded and slate-coloured tongue; the pulse was quick, very small, fluttering, easily compressed, and irregular. He had frequently had attacks of *gout*, and had been ailing for some days. Six leeches were applied to one foot, and a grain of calomel, with five of James's powder, given every four hours. Next day he was much relieved from the pain in the heart's region. Leeches were repeated on the other foot. On the following day the pain was nearly gone. The James's powder and saline medicines were continued, and also the pediluvium with mustard and vinegar. On the third day, the pulse was quite subdued, but frequent and intermitting; the tongue had the same slate-coloured fur. Five grains of calomel were now given; after which he had a good night, and a belladonna plaster was applied to the chest. On the following day, the peculiar fur on the tongue had disappeared; the calomel acted once on the bowels; the pulse was diminished in frequency, and regular; on the sixth day, he returned home convalescent. After repeated similar attacks, he died three years afterwards, and I received the following account of the morbid appearances:—

"The pericardium contained much water, the right auricle and ventricle very much enlarged and filled with blood. The left ventricle was so relaxed that it was flattened, and the apex of the right ventricle extended beyond it. The mitral valves were in some parts greatly thickened, and so were the tricuspid. The walls of the left ventricle were flaccid and pale."

Conclusion.

In treating of the inflammatory diseases of the heart, I have dwelt at considerable length on the gouty inflammation of that organ; and have been prompted to do so, not only because gouty affections of the heart are very frequent, and that gouty inflammation lays the foundation of many of the organic changes of this organ; but also, because this malady—a malady from which so many symptoms originate—has been overlooked by those authors who have treated of the diseases of the heart; and who have attempted to reveal the diseases of this important organ by "ausculation," totally disregarding the physiological symptoms. Had these symptoms created the same spirit of inquiry as the sounds of the heart, it is difficult to conceive how so very frequent a disease as the gouty affection of that organ should not have been fully and satisfactorily described. Hence it happens, that from the nature of one of the heart's most important maladies not having been recognised, the proper means to be employed for its treatment could not have been pointed out.

Recapitulation.

That the reader may be enabled the more clearly to comprehend the account which I have given of the gouty affection of the heart, the chief points may be briefly recapitulated.

1*st*, That, in all cases of gout, the action of the heart is disturbed from the earliest appearance of the symptoms.

2*dly*, That the morbid changes in the valvular apparatus of the heart are more frequently the products of arthritic than of any other inflammatory affection.

3*dly*, That the phenomena of gout are, in all respects, analogous to those phenomena which are developed in other specific diseases.

4*thly*, That gout, whatever organ may be affected by it, ought to be regarded as one specific disease; and that the different species into which it has been divided are only modifications of one and the same malady.

5*thly*, That gout attacks only particular tissues—the serous, the mucous, and the synovial membranes, and the skin.

6*thly*, That when gout affects the heart, the inflammation is seated, either in the pericardium, or in the endocardium.

7*thly*, That gout may be translated either from the heart to the extremities, or from the extremities to the heart.

CHAPTER XLVI.

THE RHEUMATIC INFLAMMATION OF THE HEART.

General observations on rheumatism of the heart; the original observations of Wells, Pitcairn, and Baillie on this disease; the tissues of the heart which are affected by it; the changes which take place in them; in what respects these changes differ from those produced by arthritic inflammation; the changes of the blood in rheumatism; the large proportion of fibrine in rheumatic blood; differences in the constituents of rheumatic and gouty blood; this accounted for; the causes of rheumatic inflammation of the heart; the heart and joints simultaneously affected; those who are most frequently affected with rheumatism; rheumatism combined with plethora and gout; the physiological symptoms of rheumatic inflammation of the heart; condition of the digestive organs; changes in the urine; changes in the pulmonary, and in the cerebro-spinal systems; changes in the impulse and sounds of the heart, and in the cardiac and arterial pulse; changes in the sensibility and resonance of the chest; symptoms of acute inflammation of the pericardium and endocardium; these membranes may be inflamed separately or simultaneously; diagnostic characters of rheumatic inflammation of the heart; exanthematous inflammations of the heart; treatment of rheumatism of the heart.

Until the observations published by Wells, Pitcairn, and Baillie,[1] a rheumatic affection of the heart had not been described by any pathologist; though some subsequent writers on this subject have been so uncourteous to those authors as not to notice their writings, thus denying them the merit of originality. I may, however, remark, that in the voluminous and prolix works on this subject which have since appeared, little additional matter will be found either interesting to the pathologist or useful to the practitioner. The phenomena of rheumatic and idiopathic inflammation have been always confounded, whilst gouty inflammation entirely escaped observation. Had their inquiries been more directed to the physiological symptoms, and to the history of these inflammatory affections, than to the mere *physical signs*, the differences in the character of the arthritic and rheumatic inflammation of the heart could scarcely have failed to have been discriminated.

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[1] *On Rheumatism of the Heart,* by William Charles Wells, M.D., in the *Transactions of a Society for the Improvement of Medical and Chirurgical Knowledge.* Vol. iii. London, 1812.

In different species of rheumatism.

In the whole category of diseases none differ more than the three species which nosologists have arranged under the genus rheumatism—the *articular*, the *muscular*, and the *neuralgic*. The phenomena of each of these species—the tissues which are affected by them—the causes that produce them—the condition of the sanguiferous system accompanying them, and the treatment which each species requires, are all perfectly dissimilar.

Tissues of the heart affected by rheumatism.

In the heart, rheumatic inflammation is always seated in its *serous* membranes; in the same manner as in articular rheumatism, the inflammation affects the capsule of the joints.

That rheumatism does not affect the *muscular* tissue of the heart, we may, I think, venture to infer from the circumstance, that such an attack would prove instantly fatal. It is well known, that when a muscle is attacked with rheumatism, such as we so often observe in the muscles of the neck and loins, any muscular action suddenly becomes so acutely painful as to render its contractions quite insupportable. It therefore seems to me highly probable that acute rheumatism never affects the muscles of the heart, nor any of the organs of organic life. Neither have we any satisfactory evidence that the cardiac *nerves* are ever affected with rheumatism, for, did that happen, life would certainly be immediately extinguished. The nervous and the muscular systems of the heart, unlike those of other portions of these systems, would, therefore, seem to be exempt from a disease, an attack of which would, instantly, prove fatal, though so very frequent in the organs of organic life.

Of rheumatism.

Whilst arthritic inflammation usually attacks the endocardium, the pericardium is most frequently the seat of rheumatism; though both these membranes are, in many instances, simultaneously inflamed.

Their morbid changes.

The morbid changes, which are the effects of rheumatic inflammation either of the pericardium or endocardium, are, in most respects, like those of arthritic inflammation. There is effused on both those serous surfaces, coagulable lymph, and a sero-albuminous fluid is collected in the cavity of the pericardium. The lymph varies in quantity and in consistence, forming on an adventitious membrane, which produces adhesions between opposite parts of the surface of the pericardium, and on the endocardium, producing those various changes in the thickness and form of the interior surface of the heart, and of the valvular apparatus.[1]

Lymph effused.

The *eye* affords a favourable opportunity of observing the characters and morbid changes of rheumatic, as it does of arthritic opthalmia; and were the opportunity afforded to examine other organs, the same morbid phenomena would no doubt be recognised.

Although these changes in rheumatic inflammation appear very similar to those in the arthritic inflammation, yet, in one respect, they differ essentially; none of the cretaceous matter, *the urate of soda*, which I have shown to be pathognomonic of gout, being ever deposited in the tissues which have been affected with simple rheumatic inflammation.

Changes in the blood.

The condition of the sanguiferous system in rheumatism points out the important share which the *blood* has in the production of some of the phenomena of that disease. At the same time, it must be admitted that chemical analysis has only made known to us the changes of rheumatic *venous blood* taken from the arm, no analysis having been made of arterial blood.

Characters of rheumatic blood.

Rheumatic venous blood is essentially different from gouty blood; for although we have in gout and plethora combined an excess of *fibrine*, yet the urate of soda, an element in gouty blood, has not been found in rheumatic blood.

The blood in acute rheumatism possesses the same morbid characters as the blood in all inflammatory affections, but the quantity of *fibrine* is generally greater in the rheumatic than in the blood in other febrile diseases.

Difference in the form of gouty blood.

This remarkable difference in gouty and rheumatic blood accords with the difference in the causes which produce these diseases; the blood of gouty persons is vitiated by a long-continued derangement of the excrementitious and incrementitious processes, and contains entirely *new* elements; the rheumatic blood is changed suddenly from some atmospheric influence, and has only the *proportions* of the natural constituents of the blood changed.

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[1] Kirk has shown that these portions of lymph are sometimes detached from the endocardium, and conveyed by the current of the blood to a vessel in the brain, causing paralysis.

From whence is derived the fibrine.

The question has been long agitated—From whence is this additional quantity of fibrine in rheumatic blood derived? whether it ought to be considered as a morbid product, or an increase of that same element which constitutes strength? As the *fibrine* has been considered to be that constituent of the blood which constitutes strength, it appears contradictory that an increase of its proportions should become one of those remarkable changes of the blood in inflammatory diseases.

There are two phenomena connected with inflammatory diseases which are remarkable in rheumatism. Not only is the proportion of fibrine in the blood increased, but the inflamed part separates fibrine from the blood, forming a morbid product. The circumstance of increasing the fibrine during the process of inflammation, shows that it must be eliminated in some other manner, or from some other materials than those from which it is furnished to a person who is in health. The emaciation, or loss of flesh, which takes place to so great a degree in persons suffering from any of the *phlegmasiæ*, may explain the great increase in the proportion of fibrine which the blood contains in those diseases. The muscle, the chief element in the composition of which is fibrine, and which is so rapidly absorbed during inflammation, must go somewhere, and why not to the blood?

In all febrile, as well as inflammatory diseases, we may observe that excrementitious processes are performed by the different organs; by the alimentary canal; by the kidneys; and by the pulmonary and cutaneous surfaces: when these excrementitious processes are not duly performed, the vitiated elements in the blood are then deposited in different cavities, or in the *parenchyma* of different organs. The mucous membranes secrete a *muco-puriform* fluid, the cellular membrane secretes *pus*, and the serous and synovial membranes secrete *fibrine*.

Causes of rheumatism of the heart

Rheumatic inflammation of the heart can usually be traced to an exposure to cold and moisture, such as sitting in wet clothes;

sleeping in a cold and damp bed; getting wet feet; taking a cold drink when overheated.

Cases recorded by Wells.

In one case the attack came on three days after being heated in a theatre, and whilst in that state drinking a considerable quantity of "porter."

In another case, the attack came on by falling into a pond of water when suffering from articular rheumatism.

In a third case, a woman, while suffering from an attack of articular rheumatism, caused by standing some time in a cold cellar, wetted her feet: two days after the pains in the joints abated, and she was attacked with palpitation.

In several instances I have known it caused by sleeping in a damp bed.

Heart and joints affected simultaneously;

When rheumatism affects the heart it is sooner or later followed by pain in some of the joints of the extremities; or the serous membranes of the heart, and the synovial membranes of the joints, are simultaneously inflamed. That in all cases of articular rheumatism the heart is affected, we may conclude from the derangement in its functions at the very commencement of the febrile symptoms.

or it may be translated.

In some instances, rheumatism, like gout, is *translated* to the heart from the extremities, or from the heart to the extremities; the phenomena, observable in rheumatism of the heart, being analogous to those of gout.

In whom most frequent.

Whilst gout rarely affects young people, rheumatism, on the contrary, is met with in persons of all ages and of both sexes.

The comparative frequency of rheumatic and arthritic affections of the heart in different classes of society is a striking feature in the history of these diseases; for whilst *gout* is usually met with amongst those who consume a large proportion of animal food, and lead a life of sensual gratification, rheumatism is most frequent in those who live chiefly on milk and vegetables, and who are exposed to much bodily fatigue, and many atmospheric changes.

This comparative difference in the frequency of rheumatic and gouty affections in the two classes of society, affords a striking proof of the danger of drawing general conclusions, or of attempting to give rules for the treatment of diseases from observations made only on particular classes. Surely the same ailment in a soldier or sailor, and in a person of delicate constitution and luxurious habits, must have, in many respects, a very different character.

The same remark forcibly applies to rheumatic inflammation of the heart, the cases of rheumatic *pericarditis* referred to by different writers have almost all of them been selected from public hospitals; whilst this disease, especially in its more severe forms, is comparatively of rare occurrence in the opulent classes of the community.

Rheumatism combined

The complications of rheumatism with other diseases merit consideration. The heart, when attacked with rheumatism, soon participates in any constitutional peculiarity or derangement of the general health which may have existed previously.

with plethora, and with gout.

If the patient be plethoric, the attack assumes a form which is accompanied by general *plethora*.

If the person be of a gouty diathesis, the rheumatic attack is modified by that diathesis: such combinations must have led nosologists to divide rheumatism into certain species.

Symptoms and Diagnosis.

The physiological symptoms.

It is by the *physiological* symptoms alone, the same as in gout, that we are enabled to distinguish rheumatic affections of the heart. It appears incredible, that so many inquirers into the diseases of the heart should have remained quite satisfied with a detailed account of its morbid changes, and not have investigated the condition of the general system by which the changes were produced. Such an inquiry would not only have pointed out their true nature, but would have afforded a legitimate channel to the discovery of some appropriate remedies.

Thus far we have contemplated rheumatic inflammation of the heart in its acute form; but rheumatism, like gout, is met with in every possible degree of intensity and duration. In those who have suffered from rheumatism of the heart, a chronic state may continue long after the febrile condition has abated. Like other inflammatory diseases, we may therefore anticipate that in rheumatism there will necessarily take place all the different degrees of vascular turgescence, from that state of the capillary system, where the increased redness appears to be chiefly caused by arterial blood, to those cases where the turgid vessels are chiefly distended by venous blood.

In narrating the symptoms of rheumatic inflammation of the heart, I am necessarily compelled to mention some which may appertain to *pericarditis*, and others to *endocarditis;* but, as in the majority of cases, both these serous tissues are affected, it would be difficult to separate the two classes of symptoms.

Condition of the digestive organs.

Whatever derangement may be detected in the *digestive* organs, it is probable, from the nature of the causes of rheumatism, that derangement may not have existed previous to the rheumatic attack; whereas in gout a derangement of the alimentary canal always precedes the arthritic inflammation.

Appearance of the tongue.

In rheumatism the *tongue* is increased in bulk, has a milk-white colour, and the central portion is generally covered with a brown fur.

The changes in the urine,

In *acute* rheumatic inflammation the *urine* is scanty, and its qualities are considerably changed. Its colour becomes of a deep red, and it deposits a copious sediment of *urea.*

in the skin,

The *cutaneous* surface is remarkable for the abundant moisture with which it is almost constantly covered; and its peculiar acrid and offensive odour is derived from the *lactic acid* which it contains.

and in the lungs.

The condition of the *pulmonary* apparatus is greatly influenced in this, as it must necessarily be in all the inflammatory affections of the heart; and the changes in respiration, caused by changes in the pulmonary circulation, differ strikingly from those which are caused by diseased lungs. The breathing becomes more rapid, and the inspirations and expirations are proportionably shortened, when a portion of lung is unfit to oxygenate the blood. In the inflammatory diseases of the heart, the pulmonary circulation deranges the regularity of the inspirations and expirations, and the instinctive acts of sobbing and sighing are resorted to by the *vis medicatrix* to restore and preserve the balance of the circulation.

The *pulmonary exhalation*, like that of the skin, is often much tainted, and has a similar acid smell.

In rheumatism of the heart there is always a great disturbance of the *cerebro-spinal* system; the derangement in the circulation of this system is marked by want of sleep, a distressing restlessness, and changing of posture. There is also an appalling expression in the countenance characteristic of the greatest anxiety, and even of terror, which leaves an impression upon an observer that he never can forget. This *facies propria*, so remarkable in some diseases of the heart, is quite unlike the expression of those suffering from diseased lungs.

The anatomical symptoms.

As rheumatic inflammation of the heart varies in every possible degree, its symptoms are also variable in their intensity.

In acute articular rheumatism, the action of the heart is much changed. The frequency of the beatings of the heart is greatly increased, and the arterial pulse becomes not only extremely rapid but vibratory. The *impulse* is increased, and the beatings are generally to be perceived by placing the hand upon the chest, and even so intense as to be felt by the patient.

Changes in the impulse.

The peculiar *vibratory* feeling in the arterial pulse, which has been long noted as characteristic of rheumatism, indicates a condition of the heart different from the change in its action which accompanies inflammatory diseases of other organs.

Signs derived by percussion.

By *percussion* the precordial region is found more or less dull; and the chest is sometimes more prominent; from the displacement of the lungs there is also an absence of the respiratory murmur over this space.

Louis.

The local pain.

If the inflammation be seated in the *pericardium*, there is tenderness, and more or less pain, referred chiefly to the region of the heart; these are increased by pressure, by a full inspiration, or by coughing, symptoms resembling those of an inflamed portion of pleura.

Changes in the sounds.

An inflamed state of the pericardium can have no more influence in changing the currents of the blood than any other cause which alters the functions of the heart; but no portion of the *endocardium* can be inflamed, without producing some changes in the currents of the blood; and there will be changes in the currents and consequently in the *sounds*, according as the inflammation is seated in that portion of the endocardium which covers the right or left heart, or in the auricle or ventricle of either heart.

The intensity of the *sounds* is increased during the first period of the inflammation of the pericardium, but they become dull, according to the quantity and to the density of the effusion into its cavity. As in many other of the heart's diseases, the "bellows-sound" has also been remarked in pericarditis; but this sound cannot be considered as an unequivocal sign, either of pericarditis or endocarditis, for it is present in many other diseases of the heart, both functional and organic.

Pericardial friction.

A sound of *friction*, such as that of a file, or of dry leather, has been described by auscultators, and supposed to be caused by the mechanical rubbing of the opposite surfaces of the diseased pericardium; this opinion has been retailed from one author to another, as a satisfactory explanation of this peculiar sound.

Explained erroneously.

Admitting the possibility, that sounds of friction exist when the surfaces of the pericardium are covered with a lamina of coagulated lymph, and its cavity is more or less filled with a sero-albuminous fluid, is it legitimate to suppose that any friction of the surfaces of this capsule caused by the motion of the heart could produce an audible sound? The fallacy of such a hypothesis is proved by the effect that is known to be produced by rubbing two rough files, or of clipping a piece of glass while under water. The vibration is, in these experiments, so greatly checked, that the sounds are nearly destroyed, or at least rendered imperceptible. How, therefore, can credence be given to the opinion, that an audible sound could emanate from a cavity, such as the pericardium, filled with a substance of the consistence of coagulable lymph, when the parietes are moved by the motions of the heart? And when adhesions have taken place betwixt the opposite sides of the pericardium, still more untenable must be the hypothesis, that any sound could emanate from the movements of the heart by causing friction of the opposite sides of the pericardium. The affectation of displaying a nicety in distinguishing such sounds has doubtless led to most unphilosophical modes of explaining some of them; and many mischievous effects have arisen from erroneously attributing these sounds to particular morbid changes in the heart's structure.

Symptoms of the inflamed endocardium.

When the inflammation is seated in the *endocardium*, there is little or no local pain, but a feeling of oppression in the region of the heart. The beatings of the heart are perceptible to the hand, when placed on the precordial region, and they are sometimes so violent that they elevate the ribs.

The principal symptoms of an inflamed state of the *endocardium* arise from the changes which must necessarily take place in the currents of the blood passing over the inflamed surfaces of the heart's cavities. The intensity, the rhythm, and the characters of the sounds are varied, according to the seat, the extent, and the degree of the inflammation.

The inflamed state of the endocardium, and the masses of coagulated lymph adhering to its surface must cause a great disturbance in the action of the heart, necessarily changing the characters of the cardiac and arterial pulse, and likewise of the sounds of the heart. The beatings of the heart are irregular, unequal, and intermittent. The arterial pulse is small, very frequent, contracted, unequal, irregular, or intermittent. Whilst the arterial pulse is small, the heart beats violently; and it has sometimes been remarked, that the number of the arterial and cardiac pulsations did not correspond.

Bulliaud.

Pericarditis and endocarditis combined.

As has been observed, that in most cases of rheumatic carditis both the serous membranes of the heart are affected, the symptoms may, therefore, become variously combined; the inflammation frequently extends to the serous membrane of the lungs; the symptoms, then, become still more complicated, their assemblage depending on the extent, as well as on the degree, of the inflammation of the inflamed surfaces.

Pericarditis, endocarditis, and pleuritis combined.

Pericarditis and *pleurisy* may indeed be mistaken one for the other, and care is necessary to distinguish them. One striking difference is, that the countenance in pleurisy wants that expression of terror and despair so characteristic of pericarditis. In pleurisy, the local pains are more severe, there is great difficulty and pain in expanding the thorax, the inspirations are always shortened, and not irregular, as in pericarditis.

Diagnosis of rheumatic inflammation.

The circumstance that some of the phenomena of *rheumatism* resemble those of *gout* has led those diseases to be often mistaken the one for the other. But the striking difference in the causes that produce them; the different systems of the economy that are affected; the morbid changes these diseases produce in certain tissues, and also in the blood; and especially the treatment best adapted for each of them, sufficiently point out the differences of the arthritic and rheumatic inflammations of the heart. Such discordant opinions have, I apprehend, arisen from the peculiar assemblage of symptoms which frequently appears, when rheumatism affects a person of a gouty diathesis; and likewise from certain elementary tissues being liable to both diseases.

The treatment most appropriate for the one disease is as different from that required for the other, as the causes that produce them. In gout the chief curative indications are directed to improve the incretions and regulate the excretions; but in rheumatism we endeavour to restore the disturbed functions of the cutaneous capillaries. The history of the case, the rapidity in the action of the heart, the vibratory pulse, and the fixed or erratic pains in the limbs and joints—all point out the rheumatic character of the inflammation.

On examining the numerous writings on endocarditis and pericarditis, it must appear evident, that the descriptions therein given apply both to arthritic and rheumatic carditis; whereas, as I have already said, except in inflammation caused by wounds or external violence, all the inflammatory diseases to which the heart is subject are of a *specific* character.

In this category I include, besides gout and rheumatism, those inflammatory affections of the serous membranes of the heart, which come on after the febrile symptoms of *measles*, *small-pox*, and *scarlatina* have abated; and which are caused from exposure to a sudden change in the temperature of the atmosphere; to an imprudence in regimen; or to a loaded state of the alimentary canal.

The same observation is applicable to all other inflamed serous membranes, as well as to those of the heart. Unless in cases where the *testis* has been inflamed from an injury, or from sympathy with a disease in the urethra, we never see effusion into the inflamed vaginal tunic but in persons of an arthritic diathesis. Unless when a *joint* has been inflamed from an injury, how seldom do we observe it diseased but from scrofulous, from rheumatic, from arthritic, or from a syphilitic inflammation.

This opinion is corroborated by observing the inflammations of the eye, where the capsule of the aqueous humour is inflamed. That serous membrane is never inflamed, except from an injury, but in those persons who have some specific disease.

The pleura and the peritoneum may be deemed exceptions to the preceding observation; being examples of serous membranes frequently affected with common or idiopathic inflammation. This circumstance, however, admits of a satisfactory explanation, as those membranes are much exposed to vicissitudes of temperature. The cold air transmitted into the lungs is brought into almost immediate contact with the pulmonary pleura; and the peritoneum is not effectually protected from the influence of cold from without, nor from internal agents, as most other serous capsules are.

From what has been said, an important practical doctrine is established,—that we ought to suspect the existence of some specific disease, whenever any of the serous membranes of the heart are affected with inflammation; and more particularly if that inflammation assume a sub-acute or chronic character.

Treatment.

The treatment which should be adopted in the acute form both of rheumatic endocarditis and pericarditis is precisely that which is usually employed in severe rheumatic inflammation of other organs. This treatment has been distinctly pointed out by those authors to whom we are indebted for the first account of this disease.

Emetics.

When rheumatism is caused by some change in the functions of the cutaneous capillaries from a sudden alteration of temperature, the first curative indication should be, to restore the function of the skin. There is no remedy so powerful for effecting this purpose as an *emetic*, and the exhibition of the *tartarized antimony*.

"In several cases of chronic *rheumatism* I have, by the full effect of an *emetic* (antimonial), succeeded in dislodging from the stomach a load of viscid and opaque *mucus*, followed by dark, slimy, and fœtid stools." Barlow.

Blood-letting.

The local pain and difficulty in respiration will also require for their relief the abstraction of blood; this is most effectually accomplished by *phlebotomy*. The quantity of blood to be taken must be entirely regulated by the effect produced on the cardiac and arterial pulse, whilst the blood is flowing from the vein; and even should the action of the heart become subdued, it ought afterwards to be carefully watched, and more blood abstracted by renewing the application of the bandage on the arm, whenever the pulse acquires volume and the local symptoms return.

It is after the febrile symptoms have been relieved by general blood-letting and other depletive means, that local blood-letting, such as the application of *leeches* on the precordial region, or upon the feet, may be advantageously employed. *Opium* combined with *calomel*, and opium taken singly, or *Dover's Powder* and calomel, are also appropriate remedies during the more acute symptoms.

When the acute symptoms have been subdued, and when the disease of the heart assumes a more chronic form, then besides rheumatism, there is generally some other disturbance in the system, more especially a combination with gout, by which the rheumatism is modified, and which requires additional treatment. In such cases those remedies become necessary which improve the *incretions*, as well as those that regulate the *excretions;* this is to be effected by employing those means which have been already explained.

The excessive perspiration which accompanies acute rheumatism may be often relieved by *Dover's Powder*. On the same principle, that an emetic arrests vomiting and a purgative diarrhœa, so will a diaphoretic check a profuse perspiration.

The powerful influence of *mercury*, combined with squills or digitalis, in promoting absorption, renders its use particularly applicable to those cases where there is much effusion in the pericardium.

The *cinchona* has long been in repute for the treatment of chronic rheumatism, or after the more acute inflammatory symptoms have been subdued. The powder of cinchona, combined with the *carbonate of soda*, given in five-grain doses of each, every two or three hours, is a most useful remedy. As healthy venous blood contains carbonate of soda, is it not probable that the medicinal effects of soda are produced through the medium of the *blood?*

The *hydriodate of potass* and *colchicum* may also be advantageously employed. *Counter-irritants* are no less useful in rheumatic than in arthritic carditis.

I have often observed the most decided benefit from a couple

Chap. XLVI. of grains of the hydriodate of potass taken two or three times a day, in those who have suffered from rheumatism, and in whom, after the local symptoms have abated, the action of the heart continued disturbed.

In concluding these observations on the treatment of rheumatism of the heart, I may observe, that rheumatic *ophthalmia* affords an excellent opportunity of watching the influence of the curative means employed; for although a just estimate may be formed of the effects of remedies, when the disease is in the heart, from the changes in the symptoms; yet in the ophthalmia the various changes can be *seen* going on in the vascular system of the eye, and thus the precise effect of the curative means that are adopted can be distinctly ascertained.

CHAPTER XLVII.

DISEASES OF THE CORONARY VESSELS.

Diseases of the different tissues of the heart; the diseases of the coronary vessels, functional and organic; our limited knowledge of these diseases; their importance; peculiarities in the arrangement of these vessels; Abernethy's observations on the foramina of Thebesius; pathological inferences; coronary congestion; dilatation of the coronary arteries; inflammation of their coats; ossification; aneurism; general observations on the symptoms, diagnosis, and treatment of the diseases of the coronary vessels.

We next proceed to consider the diseased changes which take place in each of the particular tissues of the heart: consistently with the original design of this work, it is not my intention to collate the numerous materials which are to be found in medical writings on this subject. The museums which abound not only in this metropolis, but also in many parts of the British dominions, and which vie with each other in their intrinsic value, and in the liberal manner they are thrown open to the student, have materially contributed to promote the knowledge of morbid anatomy. With the aid of the excellent "catalogues" of the morbid preparations, which have been published, these collections may be most advantageously consulted by all who have an opportunity of examining them during their pathological investigations on the diseases of the heart.

Considering the number of zealous inquirers into the pathology of the heart, it is remarkable that the diseases of the *coronary vessels* should not have been more carefully investigated. With the exception of a few morbid changes in their coats, little notice has been taken in systematic works of the maladies of this important system of vessels. The circumstance of these vessels carrying on a separate and distinct circulation, and being the nutrient vessels of the heart, would, it might have been expected, have created a great interest in investigating their diseases.

The relation which subsists between the functions of the heart and the coronary vessels, must inevitably cause a reciprocal influence in their functions, when they are diseased; for as, in the healthy condition of the circulation, every change in the heart's action, however slight, or however temporary, must cause some change in the coronary circulation, it is legitimate to infer, that changes in the heart's functions from disease must be accompanied by corresponding changes in the circulation of the coronary vessels.

That arteries perform most essential functions in the animal economy is exemplified when those of a limb become ossified. The heart then not being alone sufficient to carry on the circulation, sooner or later the limb mortifies,—from which we may infer that great changes must take place in the heart's functions from changes in the condition of the coronary circulation. The general circulation, it would indeed appear, can be much better carried on without the aid of the heart than without that of the arteries. This may be explained from the fact, that the left heart is more frequently diseased than the right; and still less frequently are both diseased at the same time: so that, although the left ventricle cannot assist in propelling the blood when its parietes are ossified, the impetus given to the stream by the right heart is, along with the action of the arteries, sufficient to carry on the circulation, and thus life is prolonged. It is for this reason "that we uniformly find, when the ventricles are ossified, that the flesh of the auricle is firmer and stronger than usual." Burns *on the Heart.*

Peculiarities of the coronary arteries.

The coronary vessels, both arteries and veins, as I have shown, constitute a circulation which is not analogous to that in any other organ. The origin of the *arteries* at the commencement of the aorta; their orifices being so placed and of such a form as to receive the regurgitating, as well as the affluent stream of the aortic blood; their course being such that the flow of blood in them can never be interrupted by the contraction of the muscular parietes of the heart are all striking peculiarities in the arrangements of these vessels. See Chap. I.

The direct termination of the coronary *veins* in the right auricle, and in the right ventricle, are peculiarities in the structure of the veins; and the special functions of the organ, which the veins supply, prepare us to meet with peculiarities in their pathological phenomena, and to find them executing an important share in the diseases of the heart.

The foramina of Thebesius.

Prosecuting our inquiries into the pathology of the coronary arteries, there is a point regarding their anatomy which it would be most important either to establish or to refute,—I allude to the termination of some branches of these vessels in the left ventricle, which has been demonstrated by some, and denied by other eminent anatomists.

The explanation which I have offered of the phenomena of congestion of the cavities of the heart and coronary vessels, seems to afford additional confirmation of the opinion of those anatomists who have asserted, that branches of the coronary arteries terminate by open mouths both in the left auricle and also in the left ventricle.

I have endeavoured to explain by what means the economy regulates the quantity of blood within the heart, and how it is relieved from any undue quantity of blood by modifications in breathing. These processes, however, though they relieve the cavities of the heart, do not appear calculated to diminish the blood in the congested coronary vessels. For effecting this purpose the peculiar arrangement of some branches of the coronary arteries, terminating in the left side of the heart, may be assigned.

The ingenious observations of Abernethy, to which I have alluded when considering the anatomy of these vessels, appear to me to throw much light upon this interesting subject.

Abernethy has distinctly shown that, in the healthy heart, when "coarse wax injection is thrown into the coronary arteries and veins, in many cases the least quantity could not pass into the left ventricle; but, on injecting the coronary arteries and veins of persons whose lungs were much diseased, the injection readily flowed into the left ventricle."

Phil. Trans. 1798.

Congestion of the Coronary Vessels.

When explaining the nature of congestion of the cavities of the heart, I pointed out that it must necessarily be accompanied by a corresponding state of the coronary vessels; a congested state of the coronary *arteries* accompanying congestion of the systemic heart, and a congested state of the coronary *veins* accompanying the congested pulmonic heart.

Pathological inferences.

Whenever there has been a congested state of the cavities of the heart, and a similar condition of the coronary vessels, it must not be concluded that a restoration of the heart's functions will always re-establish the healthy state of the coronary circulation; on the contrary, these vessels may continue more or less congested; and when the coronary circulation is disordered, changes must take place in the tissues of the heart which these vessels supply. Besides an increase of the muscular parietes, the cavities of the heart are enlarged; and when the muscular tissue has likewise become pale and softened, the coronary arteries have been found much *dilated.*

Diseases of the coronary veins.

In the heart, as in other organs, vascular *congestion* may either be *arterial* or *venous*, or both systems of vessels may be simultaneously congested. The *coronary veins*, by discharging their blood directly into the right auricle, the circulation will be modified in the various states of congestion of the *pulmonic* heart; but there never can be any regurgitation of the blood in the veins from the right auricle, in consequence of the valves with which these orifices are provided.

The coronary veins have usually been found *enlarged* where the muscular structure was changed; and it is highly probable that a congestion of blood in the veins of the muscles of the heart will modify their condition, in like manner as the muscles of the limbs become inert when the venous circulation in them is interrupted by wearing tight garments, or by applying a ligature on the limb.

That congestion may take place in the coronary vessels, independently of congestion of the cavities of the heart, is probable, from a similar change taking place in the vascular system of other organs. After an inflammatory attack, we are familiar with a congested state of the blood-vessels of the cerebral, of the pulmonary, of the portal, of the uterine, of the mucous, and more especially of the cutaneous system; for in it we can readily, during life, see the congested state of the capillaries.

Contemplating the *inflammatory* affections of the heart, we are naturally led to inquire into the condition of the coronary vessels; as it is impossible to conceive, that the capillary system of the tissues of the heart, when affected with inflammation, should not produce some decided effects upon the whole system of the nutrient vessels of the heart. It is indeed surprising, that pathologists, when inquiring into the phenomena of cardiac inflammation, should not have investigated the morbid changes of these vessels: we may therefore infer, that their diseases have been confounded with those of other tissues of the heart, and that they must have caused much obscurity in the symptoms, and very erroneous opinions in the diagnosis of these diseases.

Diseases of the coats of the arteries;

That the coats of the coronary arteries, like those of other arteries, are liable to *inflammation*, is shown from morbid changes being found in them which are known to be the result of inflammatory action. Thus lymph is effused upon the surface of their internal membranes, and the membrane itself has the same reddened appearance or stain so common in arteries of other inflamed parts; and these vessels preserve their relative position as regards the muscular parietes of the heart, even when they are greatly diseased.

Their ossification.

The only disease of the coronary arteries, which has created much inquiry, is the *ossification* of their coats. These vessels are very often found ossified, particularly their orifices, and sometimes the ossific deposit is so complete, that they are converted into bony canals. In old people, nothing is more common than to find scales of bone over the whole extent of these arteries.[1]

"Dr. Jenner, who was a clear-headed man, said, if ever John Hunter dies, and is examined, I am sure you will find the *coronary vessels* of his heart ossified; and this certainly was the case;—it is a fact, that the coronary vessels of Mr. Hunter's heart were ossified."

Abernethy's *Lectures.*

It is probable that the ossification of these arteries is the cause of that syncope so frequent in the aged, and which, when prolonged, often proves fatal.

Case.

A lady nearly eighty years of age enjoyed good health until five years before her death. During the last five years of her life, whenever she ascended a hill or stairs, she was compelled to stop and rest herself; frequently pressing against the region of the heart. One evening, on receiving a letter intimating good news, she rose suddenly from table, exclaiming, "Oh, I am gone," and expired. The coronary arteries were found studded with calcareous deposits. The heart was pale and flaccid, the auricles were full of coagulated blood, and the ventricles were empty.

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[1] Bichat calculated "that in every ten individuals, upwards of sixty years of age, the arteries in seven have earthy deposits.

Symptoms and Diagnosis.

In endeavouring to discriminate the changes in the functions of the coronary vessels from those of other parts of the heart's structure, I have remarked, that we meet with insuperable difficulties. We can neither be assisted by the sense of sight, nor of feeling, nor of hearing, in detecting any of these changes. There can be no alterations in the form or in the sensibility of the chest; nor is it probable that in the coronary vessels the currents of the blood could create sounds sufficiently loud not to be masked by those of the much stronger currents within the cavities of the heart. It cannot be denied, that no attempt has hitherto been made to discriminate the symptoms of the diseases of the coronary vessels from those of the morbid changes in the other tissues of the heart, especially from those of the muscles and serous membranes. The heart's functions, as well as those of its nutrient vessels, are unlike the functions of any other organ; and as the cavities of the heart are constantly filled with a stream of blood, the circulation in the cardiac vessels must produce combinations of symptoms of which we have no analogy; and which, I apprehend, from the present state of physiological and pathological science, we have not the means to reveal.

It has been already stated, that when both the coronary vessels and the cavities of the heart are *congested*, symptoms will be present; some of which are referrible to the over-distended cavities, and others to the congested coronary vessels. But when the cardiac congestion is relieved, and the coronary vessels remain congested, the chief symptoms will be those caused by changes in the action of the muscular parietes. If the action of the left ventricle be increased, the coronary arteries will be furnished with an increase of blood, although the force of the heart may not be adequate to propel the blood with its usual force into the whole arterial system.

If the coronary vessels are healthy, when the heart's action is increased, they will receive a proportional increase of blood; but if these vessels are diseased, as they will not then receive any additional increase of blood, disturbances in their circulation must follow; and hence the paroxysms of syncope and uneasiness in breathing so frequent in those who have a diseased heart.

When the coronary arteries are diseased, it must often happen that the muscles of the heart are not supplied with the wonted quantity of blood; they become pale, flaccid, and unfit to carry on vigorously the circulation. Hence there is an assemblage of symptoms from an undue distribution of the blood, more especially to the cerebro-spinal system; and as those arteries in their course are placed in close contact with the cardiac nerves, symptoms arise to which the name of *angina pectoris* has been given. I have formerly remarked, that this term applies also to symptoms which are caused by other changes of the heart's structure besides those of the coronary vessels, and more especially from ossification of the valvular apparatus and aorta; so that angina ought more properly to be considered as a symptom, than as a distinct *genus* of diseases of the heart.

In attempting, therefore, to discriminate the symptoms of diseases of the coronary vessels from those of other portions of the heart's structure, we meet with many difficulties. There will be no change of form which can be detected by our sense of sight or touch; neither is it probable that the currents of the blood in these vessels create any audible sounds,—or, at all events, sounds sufficiently loud not to be masked by those of the much stronger currents of the blood passing through the heart's different cavities.

We must look for other channels of information before we can expect to reveal the diagnostic symptoms of the diseases of the coronary vessels. In some of these we must be satisfied with negative evidence; such, for example, as the effects of particular modes of treatment in relieving particular symptoms,—symptoms which are legitimately referrible to certain changes in the functions of the coronary system.

CH XLVII. Perhaps other and more satisfactory evidence of the probability of disease being present in these vessels may be derived from analogy. Diseases of the stomach, of the uterus, and of the urinary bladder, afford examples of symptoms which are not caused by changes in the *contents* of these organs, but which are produced by diseases of their vascular structures. To what can we attribute the numerous morbid changes of the *endocardium* and of the *pericardium*, and, indeed, of all the heart's tissues, but to changes in the coronary circulation? When we hear of *gout* being translated to the stomach, or to the urinary bladder, we never take into consideration either the qualities or the quantities of what their *cavities* may contain ; but we at once refer all the accompanying symptoms to changes in their vascular system : it surely must be the same with the heart ; and when it is attacked with arthritic or rheumatic inflammation, all the effects which these diseases produce cannot be derived from any change in the quantity of blood within the heart's *cavities*, but from changes in the coronary circulation.

The disturbances which take place in the heart, not only from the *translation* of diseases, but also from those affections which are so frequently caused by the suppression of periodical discharges, as the hæmorrhoidal and uterine flux, as well as from many that are the effects both of moral and physical causes, ought, I am convinced, to be attributed to changes in the coronary circulation,—changes, I may repeat, which, sooner or later, produce the various morbid alterations that are met with in the different tissues of the heart. The influence of these diseases upon the heart is precisely the same, as that with which we are so familiar in the *cerebro-spinal* system ; a congested state of the cerebral vessels being a frequent consequence of the sudden suppression of some habitual discharge, such as that from an ulcer, or from the disappearance of an eruption.

Treatment.

With regard to the treatment of the diseases of the coronary vessels, I have little to add to the observations which have been already made when considering that of *congestion* of the heart's cavities. I may, however, again allude to the beneficial influence of local blood-letting; the curative effects of which arise from the free anastomosis existing between not only the coronary arteries with each other, but also between branches of these vessels supplying the pericardium, and inosculating with the internal mammary arteries.

The abstraction of blood by *leeches*, applied on the precordial region,—a practice which is so beneficially resorted to not only in cases of congestion, but in all diseases of an inflammatory type,—produces its curative effects, in all probability, by its influence on the coronary circulation. This explanation applies generally, I apprehend, to the administration of other remedies when successfully employed in many of the heart's diseases; especially to those remedies which have so powerful an effect in subjugating the heart's impulse, and also to those remedies which change the qualities of the blood.

Whatever system of treatment it may be judicious to adopt in the early stages of those affections which ultimately produce changes in the tissues of the heart, it is clear, that when such changes have taken place, that *that* treatment must become quite inapplicable, and only those means can, with propriety, be now adopted which are calculated to relieve particular symptoms. There are, indeed, some remedies, however beneficial they may be in those acute forms of disease that precede structural changes, which must be equally guarded against in the advanced stages of organic disease. Of these I would particularly mention mercury and antimony. Thus, to correct any disturbance of the biliary secretion which may accompany an organic affection of the heart, an occasional dose of *mercury* may be proper; but the pernicious effects of that mineral on the action of the heart whenever it has been absorbed into the blood, is, in such cases, always injurious. So, likewise, as regards the preparations of *antimony*, the influence which these have in diminishing the heart's vigour, renders their administration more or less dangerous, when, from any organic changes of the heart's apparatus, there is much hindrance to the circulation of the blood.

In the treatment of the diseases of the coronary vessels, as well as of all the organic affections of the heart, attention should be directed to those means which prevent the general circulation from being disturbed; for it is quite evident that when, from whatever cause, the action of the heart is increased, there will also be an increase in the circulation of the coronary arteries. Hence the danger of passion, or of any unusual bodily exertion; and hence the propriety of observing mental and bodily tranquillity, together with abstinence from all stimulating food or drink.

Speaking of *angina pectoris*, and the observation applies in general to all organic affections of the heart, Burns judiciously observes:—"In this, as in most other affections of this organ, we must abstain from the use of *stimuli;* the patient, if he does more than merely regulate, must take the responsibility upon himself. Few, however, until too late, can be persuaded of the necessity of self-denial; and few will submit to the privations which, in this complaint, are indispensably necessary."

Of the treatment to be adopted, during a state of *syncope*, in those suffering from angina, the same distinguished author observes:—

"During a paroxysm of syncope, we are, even though the pulse is weak and faltering, to abstract a few ounces of *blood;* for, sometimes, the heart is prevented from beginning to act again by the blood with which it is overloaded. In this state of matters, by opening the jugular vein, and gently pressing on the chest, we endeavour to expel a portion of blood from the right side of the heart, for the very same reason that we employ the lancet in suspended animation.

"Cold application to the head and chest should also be employed; and, when the breathing begins, and the patient, after a long interval, fetches a deep convulsive sigh, *ammonia* may be held to the nose, or given in the stomach, combined with aromatics; and, for the same purpose, artificial respiration may be resorted to.

"But while the person is in either a state of actual fainting, or just recovering from this condition, let the practitioner be aware of the effects of stimuli, with the view of rousing the patient. By these, the heart just beginning to emerge from the temporary cessation of function, will be made to show, for a short time, signs of returning animation; but the hope is delusive, for speedily it falls into its former state, from which no stimulant, however powerful, can again recall it."

Burns *on the Diseases of the Heart.*

CHAPTER XLVIII.

DISEASES OF THE PERICARDIUM.

Morbid changes of the pericardium; inflammation; effusion of a sero-albuminous fluid; deposits of fibrine; adhesions; deposits of a cretaceous matter, and of bone; blood and air in the cavity of the pericardium; dropsy of the pericardium; total absence of the pericardial fluid; pericardium altogether wanting; tubercles.

Inflammation.

THE pericardium presents all those changes of structure which are met with in other sero-fibrous membranes. When *inflamed*, it loses its transparency, and is increased in thickness. Its serous lamina is injected with red vessels, and infiltrated with a yellow, opaque, and sometimes with a sanguineous fluid; and its subjacent fibrous tissue may or may not be implicated in the inflammatory attack.

Effusion of fibrine.

Inflammation of the pericardium is followed, sooner or later, by the effusion of *fibrine* upon its serous surface; and a sero-albuminous, and sometimes puriform fluid, is deposited in the pericardial cavity.

Baillie's *Morbid Anatomy.*

The fibrine varies in consistence and in quantity. It is usually spread over the whole surface of the membrane; loose threads floating in the watery fluid, and masses attached to each other give it a honey-comb appearance. Sometimes the quantity of fibrine is so great, as to fill up the space between the surface of the heart and the exterior portion of the pericardial sac.

Adhesions.

When not absorbed, after the inflammation has abated, the effused fibrine gradually acquires a greater degree of firmness, becoming a distinct plastic lamina and ultimately a dense fibro-cellular structure; by the medium of which *adhesions* are formed between those portions of the capsule of the heart which are opposed to each other. The newly-formed lamina is easily separated from the subjacent serous membrane, and "there is frequently to be seen in it a slight red appearance arising from small blood-vessels ramified through it; but they are most distinctly seen by filling them with fine injection; they are sometimes numerous, and may be traced passing from the pericardium into the pulpy matter."

Baillie.

Between the adventitious lamina of fibrine and the serous membrane, there is not unfrequently a cretaceous matter deposited, which is in all probability *urate of soda;* that salt which I have formerly pointed out to be characteristic of a previous attack of *arthritic* inflammation.

The fibrous lamina of the pericardium may likewise participate in the inflammation of the superincumbent serous and serocellular tissues; and it is also liable to distinct changes, of which the *cartilaginous* and *osseous* masses frequently found underneath the serous lamina afford examples.

The 'hæmorrhagic exudation' of Laennec.

Besides these morbid changes, the effects of various degrees of inflammation, *blood* has been sometimes found effused in the cavity of the pericardium, not accompanied with any change in its structure, but connected with some constitutional disorder.

Dropsy of the Pericardium.

The pericardial fluid, like that of other serous cavities, is also liable to be morbidly increased; the membrane at the same time loses its transparency, and is increased in thickness. The pericardial fluid, in place of being a transparent serum, becomes more or less discoloured and opaque, and accumulates in various degrees. Indeed, whenever a heart is diseased, there is usually water in the pericardium before it proceeds to a fatal termination; water accumulating at the same time in the cavities of the pleura, and in the subcutaneous cellular tissue.

Anasarca.

In a few instances no moisture has been found in the pericardium, the serous surface being perfectly *dry;* in other instances a considerable quantity of *air* has been accumulated in the pericardium, and the pericardium has also been altogether wanting.

Baillie.

Besides these several morbid appearances of the pericardium, scrofulous, scirrhous, hæmatoid, and melanoid *tubercles* have been occasionally met with growing from the serous capsule itself, as well as from the subjacent structures.[1]

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[1] The concretions of the sero-fibrous membrane of the heart, which were analysed by Brand, were found to consist of phosphate of lime with "earthy matter."

Symptoms.—Reviewing the morbid changes to which the pericardium is liable, we at once perceive how difficult, indeed, how impossible it must be to assign to each of them any particular symptoms; and as the pericardium is common both to the pulmonic and systemic heart, its diseases must influence the venous as well as the arterial circulation.

When considering the rheumatic inflammation of the pericardium, I endeavoured to show how little confidence could be placed in the physical signs which some have pointed out as characteristic of that disease, especially the impossibility that a sound of "friction" could be produced by the rubbing together of pieces of lymph deposited on the surface, and floating in the cavity of the pericardium. That such an unphilosophical explanation should have been offered, appears incredible, when the fact is so well known that the friction of two bodies, when immersed in water, is scarcely perceptible. It is therefore upon the physiological symptoms and the history of the disease, that reliance can alone be placed in forming a diagnosis of the different morbid changes of this membrane.

"Many a man feels a pain in the heart when there is no disease there; but I never knew any one who was labouring under an *inflammation* of the heart, who complained of *pain* in the part actually affected; they either did not complain of pain at all, or referred it to some other part, not in the region of the heart. I have known them complain of pain in the region of the liver. But in those cases of acute pericarditis, it is not to be supposed that the disease which affects the heart will not affect the flesh of the heart, and will not render it irritable. I have known the heart to be extremely irritable, having the greatest pain, acting with the greatest force, and then, as if exhausted, it has gone on with its function in a very slow manner. Now, in describing this pericarditis, I tell the case of a physician, who had come from the East Indies, and that perhaps might have tended to mislead the minds of his medical advisers, for he died, and they really knew not what the nature of his disease was; but yet it was distinguished by this peculiar symptom that I am describing. He referred his pain to the region of the liver, as if immediately coming from the liver; he was treated as if he suffered from hepatic affection merely; but the most curious circumstance was, that one time his pulse would beat so quickly as not to be numbered, and then it would become exceedingly slow. Really, towards the last period of his life, his attendants have gone out of the room, not liking to witness his last agonies, feeling certain that, from the state of his pulse, he could not survive many minutes; and upon returning into the room again, they have found him in a languid state, with a pulse beating very low indeed, perhaps not more than forty in a minute, just as if the heart was thrown into fits of irritability, in which fits it would act with the utmost vehemence, till it became exhausted, and then carry on its functions, as I have expressed it, in a very languid manner."

Abernethy's *Lectures on Surgery.*

CHAPTER XLIX.

THE DISEASES OF THE ENDOCARDIUM.

Diseases of the endocardium; their importance in the catalogue of the heart's diseases; its morbid changes are analogous to those of other serous membranes; inflammations; their specific character; redness from an increased vascularity, and from imbibition; effusion of fibrine on the surface of the endocardium, and in the sub-serous cellular and fibrous tissues; cretaceous and ossific deposits; ulcers; warty excrescences; polypi; moveable bodies and tubercles; changes in the structure of the valves; value of physical signs; diseases of the semilunar valves of the aorta; phenomena which accompany the diseases of the valves; the unphilosophical opinions of the cause of the sounds; acoustic and hydraulic phenomena confounded; diseases of the semilunar valves; diseases of the mitral valve; diseases of the tricuspid valve; difference in the general characters of the diseases of the right and left heart; peculiarities in the structure, functions, and diseases of the tricuspid valve.

The morbid changes of the *endocardium* are, perhaps, of far more importance than those of most of the other tissues of the heart; the diseases of the lining membrane of the auriculo-ventricular cavities, with their valves and columnæ, having a great influence in all the disturbances of the heart. "It is not exaggerating," observes Bouillaud, "to affirm, that the diseases of the endocardium are the points from which most usually commence all the affections of the valves, of the parietes, and of the cavities of the heart."

The lining membrane of the right heart is much less frequently diseased than the lining membrane of the left heart. Neither is every portion of that membrane in each heart equally liable to become diseased; those parts of it which are thin and transparent being least frequently changed. Ossifications so frequently found in the lining membrane of the left heart, are never found in the valvular apparatus of the right heart. Bichat.

The endocardium is liable to those morbid alterations of structure which are common to the serous tissues; yet there are peculiarities, which arise from the purposes which it is destined to fulfil in the economy: that membrane having a highly polished surface covered with an unctuous fluid, to facilitate the stream of the vital fluid, to the contact and influence of which it is constantly exposed.

Bichat.

Effects of Inflammation.

Of the morbid changes of the endocardium, the most common are those produced by *inflammation.* All the inflammatory affections of this tissue, I have already endeavoured to point out, are of a *specific* character, being referable either to gout, rheumatism, or to exanthematous diseases.

This membrane when inflamed becomes injected with red vessels—an appearance which ought to be carefully discriminated from redness which is caused by the *imbibition* of blood. From the circumstance of the lining membrane of the whole arterial system being always in immediate contact with the blood, the blood is imbibed, and the membrane becomes stained. A similar change is observed also in other serous membranes; they imbibe the fluids they contain ; a striking example of this is seen in the gall-bladder, when the bile, oozing through its parietes, stains its peritoneal covering.

Besides an increase of vascularity, *fibrine* is effused on the surface of the inflamed endocardium; and the inflammation extends from the serous membrane to the sub-serous cellular and adjacent fibrous tissues. These lose their transparency, are thickened and indurated, become the seat of *cretaceous* and of *ossific* deposits, especially in the valvular apparatus. From the contiguity of the pericardium to the endocardium in some places, the two membranes are blended together, so that they cannot be separated.

In diseases of the heart's parietes, such as in aneurism and dilatation, a concreted and vascular limina of fibrine, resembling that which lines the sac of an aneurismal artery, has been found effused on the surface of the endocardium.

Hodgson

Sometimes, though rarely, *ulcers*, and likewise *warty* excrescences have been met with on the vascular portion of the lining membrane; and *polypi* have been frequently observed in the cavities of the heart, consisting chiefly of organized fibrine, and having a vascular connexion with the endocardium. In one case, a *moveable body*, analogous in structure to those found in the synovial capsules in the vaginal coat of the testes, and in the cavity of the pleura, was found in the ventricle. Scrofulous, scirrhous, hæmatoid, and melanoid *tubercles* are also occasionally formed in the different portions of this membrane.

Diseases of the Valves.

The morbid changes of the lining membrane of the cavities of the heart, are most remarkable in those portions, which, by their duplicatures, form the valves; changes in their thickness and hardness, the formation of warty excrescences, and of ulcers, all producing most important alterations in the direction of the currents of the blood as it passes through the cavities of the heart.[1]

Disregarding the endless disputes and the unphilosophical theories that have been formed by those who have endeavoured to explain the cause of the heart's *sounds*, and disregarding also the discrepancy in the opinions that have been offered on the character of the sounds which accompany some of the particular diseases of the heart, it must be admitted, that in none of these diseases are the physical signs of more assistance in forming a correct diagnosis than in those of the valvular apparatus.

As the characters of the two audible sounds depend on the integrity of the valves, we are naturally led to examine the changes of these sounds when investigating the diseases of the heart; and to inquire into those structural changes by which the new sounds are produced. Let us therefore review those physical signs which accompany the diseased changes in the different compartments of the heart; but, at the same time, during this inquiry we must not lose sight of the various physiological symptoms and history of the disease before venturing to pronounce an opinion of their true character; and more especially before attempting to point out the principles on which the most appropriate treatment should be conducted.

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[1] Since the former edition of this work was published, Dr. Kirkes has narrated some cases, in which portions of fibrine, which had been effused on the endocardium, had been subsequently detached, and carried by the stream of blood into an artery of the brain, causing disorganization of the adjacent cerebral substance. This important fact will satisfactorily explain many of those cases of apoplexy, which are caused by disease of the heart, and of which no explanation could be given, although the connexion between the diseases of these two organs has been long established.—*Med and Surg. Trans.*

Diseases of the Aortic Valves.

The essential difference in the office of each of the valves prepares us to meet with very different effects upon the circulation in their diseases.

By far the most important of this part of the heart's apparatus, are the *semilunar valves* of the aorta; for, as the health of all the organs depends upon receiving a due supply of the vital fluid, any obstruction to its free exit from the heart into the canal of the aorta must materially influence and derange the functions of life.

When the semilunar valves are so much thickened and indurated as not to permit the blood to pass from the left ventricle into the aorta in its wonted stream, and when the valves are so changed in their form that they cannot be closed sufficiently to stem the retrograde current of the aortic blood, the left ventricle then becomes congested, the left auricle and pulmonary veins are in their turn gorged with blood, and oppose the current from the pulmonary artery.

Symptoms.

A remarkable assemblage of phenomena accompany this condition of the heart. The respiratory function is deranged from the engorgement of the lungs, and the diminished supply of arterial blood to the cerebro-spinal and cutaneous systems causes restlessness and various uneasy sensations together with paleness and coldness of the skin and extremities.

Changes in the impulse,

Besides the effects of a diminished stream of the affluent aortic blood, the regurgitating stream produces changes in the *impulse* and in the *sounds*. The heart beats irregularly; its impulse is sometimes violent, and at other times almost imperceptible; the radial pulse is small, intermittent, undulatory, bounding,[1] unequal, and jarring; all which changes are increased by locomotion.

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[1] I have many times been able to say, by feeling the pulse, that there was ossification in the membrane of the heart. I distinguished it by a sort of *bound* in the pulse."—Abernethy's *Lectures*.

CHAP. XLIX.

and in the first sound.

When the aortic valves become diseased, the *first* sound is changed by the obstruction to the stream of blood through the contracted orifice of the valves, and it becomes a blowing murmur, or whizzing thrill. But the character of this sound is materially altered when the structure of the mitral valve is at the same time changed, or when there is a change in the valvular apparatus of the pulmonic heart.

Erroneous explanation of sounds.

When explaining the two audible sounds of the heart, I endeavoured to show that they were caused by the two great currents of the blood; the one which passes from the auricles into the ventricles, and the other when it passes from the ventricles into the arteries; and that alterations in these two currents, caused by morbid changes in the heart's structure, produced various alterations in the character of the sounds, and even produced new sounds. Such explanation of the cause of the sounds is, however, directly opposed to the opinions of those who have attributed sounds to "the flapping of valves," and who have employed a mode of reasoning, and made experiments to show the effects of currents of *air*, in order to explain the effects of currents of *blood;* thus applying the laws of acoustics, in place of those of hydraulics, to explain the heart's sounds.[1] Surely the changes in the sounds which accompany an indurated and unyielding valve, would, it might have been anticipated, have precluded so unphilosophical an explanation ever to have been offered.

Case.

A gentleman in the twenty-fifth year of his age, some members of whose family had suffered from *gout*, had a severe attack of what was considered as *rheumatism* in one knee, and which left him suddenly. The following year his breathing became quickened, and the heart's impulse increased; these symptoms were accompanied by a sense of oppression at the chest, and a slight œdema of the extremities. The symptoms gradually increased, and he died fifteen years after the commencement of the disease.

Case

The semilunar valves of the aorta were found ossified and agglutinated together in such a manner, as to leave only a very small aperture for the transit of the blood: in Fig. 26, a section of the aorta close to the ossified semilunar valves, and also the great diminution of the valvular orifice, are represented.

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[1] "It is the *tympanitic* sound of the membraneous valves which, with the time of the beats, produces the rhythm, and we judge of the existence of certain states of diseases by the degree and manner in which they are *out of tune*."—BILLING.

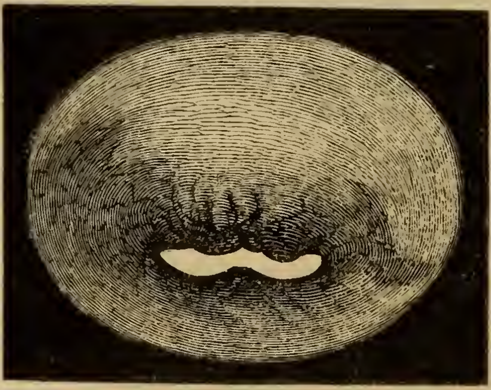

Fig. 26.

Diseases of the Mitral Valve.

Sometimes the mitral valve becomes so thickened, and its aperture so much constricted, as not to permit the blood of the left auricle to pass freely into the left ventricle. This condition of the mitral valve often accompanies a diseased state of the aortic valves.

In twenty-nine cases of valvular disease, examined by Forgeot, in nine the aortic valves were alone affected, in ten the mitral, and in the remaining ten both aortic and mitral.

When the mitral valve is alone diseased, and its aperture contracted, there must not only be a diminution in the stream of blood which enters the left ventricle, but when this valve does not close accurately, there must also be, when the ventricle contracts, a regurgitating stream of blood from the ventricle into the auricle ; a change will therefore necessarily take place in the *second* sound. In proportion as the vital stream into the left ventricle is lessened, so must the circulation through the whole arterial system be diminished, and the left auricle and pulmonary veins will become congested and dilated from the regurgitated blood.

Case. A young countryman suffered from great difficulty of breathing, and from occasional hæmoptoe. The "saw sound" was very remarkable : for some months previous to his death, he was in the habit of hearing a noise when in bed like the barking of a dog in a neighbouring farm-house. After death, water was found in the left chest, large portions of the lung apoplectic, and the left auriculo-ventricular orifice contracted; its diameter not being larger than the trunk of the common carotid artery.

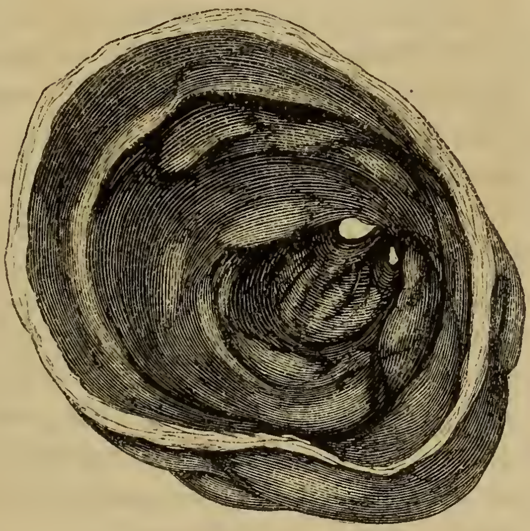

FIG. 27.

Fig. 27 represents a section of the left auricle, showing the diseased mitral valve, and the contracted auriculo-ventricular orifice.

From M. Kiernan's Collection.

Diseases of the Tricuspid Valve.

The diseases of the valves of the pulmonic are much less frequent than those of the systemic heart. "Of twenty-nine cases of valvular disease, the tricuspid was found changed only in one case, and in none was the semilunar valves of the pulmonary artery detached." It appears, indeed, that the acute or inflammatory affections attack chiefly the left heart, while the right is more the seat of chronic ailments.

Forgeot.

In a former part of this work I pointed out, at some length, the difference in the structure and in the functions of the two hearts; especially of their auriculo-ventricular valves: that valve in the systemic heart completely prevents any regurgitation of the blood into the auricle on the contraction of the ventricle, whilst the valve of the pulmonic heart is so constructed, that when the ventricle is distended, and its walls forced to yield beyond a certain limit, the valvular aperture is then widened, and a free communication established between the auricle and the ventricle. Hence, when that portion of the endocardium, the duplicature of which forms the tricuspid valve, becomes thickened, and the parietes of the right ventricle are likewise so much thickened that they cannot sufficiently yield and permit the blood to regurgitate into the auricle, the valve then becomes unable to perform the function of a "safety-valve," and various irregularities arise in the *venous* circulation.

Symptoms.

An interruption to the circulation in the *left* heart being characterized by changes in the arterial circulation, an interruption in the circulation of the venous system is equally characteristic of a disturbance in the circulation of the *right* heart. The congested state of the pulmonary vessels causes a difficulty and oppression in respiration; and the turgescence of the veins of the head renders the intellectual powers sluggish and inert; the portal system also becomes turgid,—a condition which is frequently relieved by a spontaneous hæmorrhage from the nose, the lungs, or from the hæmorrhoidal vessels.

Changes in the impulse,

The changes in the currents of the blood caused by a diseased tricuspid valve produce changes in the heart's *impulse;* the congested state of the right ventricle, which accompanies the valvular disease, increasing the force of the ventricular contractions. This increased action must influence the circulation in the pulmonary artery; and therefore we find that it is in diseases of the systemic heart that changes take place in the *arterial* pulse.

and in the sounds.

When the passage of the blood from the right auricle to the ventricle, or when the regurgitation of the blood is impeded, the second *sound* of the heart is changed, assuming different characters according to the condition of the tricuspid valve, and of the surrounding parts.

In such complicated cases various alterations must necessarily take place in the currents of the blood; and consequently in the sounds of the heart, such as we cannot suppose could be discriminated by the human ear. With this impression, we are compelled to doubt the accuracy of many of those signs that have been pointed out by auscultators as appertaining to particular alterations in the heart's apparatus. I am inclined to suspect that those physical signs, described with so much pedantic accuracy, have not been the result of actual observation, but the offspring of fertile imaginations,—an opinion which is corroborated by the numerous errors in diagnosis made by those who place their chief reliance upon physical signs.

Difficulties of the diagnosis.

When we contemplate the great number of the organic diseases of the heart,—their various stages,—their duration,—the numerous tissues which enter into its composition,—the different portion of each tissue which may be separately affected, and their combinations with the diseases of other organs, we need not indeed be surprised at the difficulty in distinguishing the organic diseases of the heart from each other.

The difficulty is still further increased, when we consider that there is scarcely one symptom of the organic diseases, physiological or anatomical, which is not to be also met with in the functional diseases of the central organ. Nevertheless, an accurate knowledge of the physiological and anatomical symptoms, together with the history of the disease, will in many instances enable a correct opinion to be formed of its nature and general character,—an opinion of far more importance, as regards the treatment that should be adopted, than any remedial means suggested merely by a knowledge of some minute changes which may have taken place in the structure of the organ. How much more rational would a system of treatment be, in a case of gouty affection of the heart, founded on the principle of treating gout *generally*, than a system based upon the knowledge of a disease of any particular portion of the serous membrane of the heart?

These remarks strictly apply to the diseases of the endocardium, as there are but few symptoms which can be said properly to belong to each of them. The only step which can with confidence be taken in order to distinguish a disease of the lining membrane of the heart, is to determine whether it be the endocardium of the pulmonic or of the systemic heart.

Treatment.

As regards the treatment of the diseases of the endocardium, I have little to add to what has been already said, when considering "The treatment of the diseases of the heart in general," and to the observations that have been made on the treatment of its inflammatory affections.

As it is extremely probable that more or less inflammation may, during the progress of organic changes in the endocardium, occasionally supervene, the presence of such inflammation should always be taken into consideration, when any system of treatment is adopted. My impression is, that the benefit so often derived from the preparations of *iodine*, *colchicum*, and *iron*, in this class of ailments, is produced by the influence which these medicinal substances are known to have on the *arthritic* and *rheumatic* inflammations, which accompany the changes in the structure of the valves; and also by their influence in promoting the absorption of the lymph that has been effused on their surface and on the sub-serous cellular tissue.

Besides the use of such remedies as may subdue any inflammatory condition of the endocardium, all those means should likewise be employed which diminish the vigour and irritability of the heart, compatibly with the functions of life.

For this purpose *neurotics*, cautiously administered, may be had recourse to; but serious consequences follow when those medicines are given in too large doses, which diminish so much the power of the heart, that from the mechanical obstruction to the circulation caused by diseased valves, the heart is unable to circulate the blood. It is under these circumstances that fatal effects have arisen from the injudicious use of *digitalis*, *hydrocyanic acid*, and *chloroform*.

During one of the paroxysms of *syncope*, so frequent in those suffering from diseases of the lining membrane of the heart, the heart being then congested and unable to propel the blood, the abstraction of a small quantity of blood from a vein, as from the external jugular, may be safely employed. This, along with the application of stimuli to the Schneiderian membrane and cutaneous surface, will assist the heart to carry on the circulation. The vital element must, however, in such cases be taken away with much caution; for, as I observed, when considering the effects of *neurotics*, if more blood happens to be removed than is consistent with the continuance of the action of the heart, life is instantly extinguished.

Analogous to the effects of blood-letting, is *dry-cupping* on the chest, or back of the neck,—a remedy which may always be unhesitatingly employed.

In the treatment of the organic affections of the heart, it is always essential to adopt all those measures which will prevent the circulation from being accelerated; and such means are more especially applicable in those cases where there is a morbid change of the valves.

The processes of *incretion* and of *excretion* should be carefully regulated by due attention to diet, and the judicious use of purgatives. *Locomotion* should be guarded against, especially any immoderate muscular exertion; and all mental excitement is equally inadmissible; for, in the more aggravated form of valvular disease, death has in many instances immediately followed a violent muscular effort or mental emotion.

By employing these different remedial agents, and judiciously adapting them to each case, it is surprising how long the lives of those suffering from diseased valves have in many instances been prolonged; and though there are many diseases of the heart which cannot be cured, we should not the less value those means by which they may be alleviated. "There is no disease, however hopeless, that does not admit of some mitigation, if not suspension, when managed according to the dictates of experience and sound pathology." Forbes.

CHAPTER L.

DISEASES OF THE TISSUES OF THE HEART.

Diseases of the muscles of the heart; peculiarities in their structure and functions; hurtful effects of fatigue; laceration of the muscles; the muscles of the heart are never affected with spasm, paralysis, nor rheumatism; increase of the muscles; terms employed to designate this condition; causes of the increase of the muscles; symptoms and treatment; diminution of the muscular tissue; softening of the muscular tissue.

Before entering upon the investigation of the diseases of the muscles of the heart, we are led to consider the nature of the functions which these muscles are destined to perform, and also to endeavour to reveal peculiarities in their organization by which they are enabled to execute an office in some respects unlike that of other muscles.

Peculiarities in the structure of the heart's muscles,

It has already been observed, that the small quantity of cellular tissue which is interposed between their fibres, and the proportionally large size of their arteries when compared with those of other muscles, are striking peculiarities in the structure of the muscles of the heart.

and in their functions.

The heart's muscles are remarkable not only for their unceasing action during the whole span of life, but for their rhythmic contractions not being interrupted, even after the cardiac nerves have been divided, or the blood has been evacuated from the heart's cavities—a phenomenon which continues, in some races of beings, after the heart has been for several hours removed from the body. Bichat says, "the motion of the heart appears to be innate, coming neither from the brain nor the blood," affording, as I have endeavoured to establish, an incontrovertible proof that the heart is endowed with a special nervous centre.

The peculiarities in the structure, and in the functions of the muscles of the heart, cannot fail to have a decided influence on the character of its diseases; and they must surely be sufficient to point out how the heart's disorders are in many respects unlike those of any other organ.

The various changes to which the voluntary muscles are exposed, materially assist in explaining the changes in the muscles of the heart.

Muscular fatigue.

The most frequent change in the condition of voluntary muscles is produced by *fatigue.* Whenever these muscles are wearied, from walking or riding on horseback, they become tender to the touch, and more or less painful when thrown into action; and they continue in this state, according to the degree of fatigue which they may have undergone.

That the muscles of the heart are liable to fatigue, we have as conclusive evidence of as we have of a like state of the voluntary muscles of animal life. Whenever, from any unusual exertion of these muscles, such as in running, the heart becomes congested, additional efforts are then made by the heart to expel the congested blood; and these efforts are, in some instances, so long-continued, that a considerable time elapses before the increased action of the heart is tranquillized, and before the uneasy feelings in the chest which accompanied it, are subdued.

But sometimes, as happens with voluntary muscles, the excited action of the heart is so long-continued, that the repose of the rest of the muscular system is insufficient to quiet it; and the heart, in many instances, continues in this state of excitement for a very lengthened period.

Effects of a sudden exertion.

Another change in voluntary muscles is that which is caused not by long-continued exertion, but by a sudden and violent muscular effort, such as is made in order to avert some serious injury, as when a person falls, or makes an exertion to prevent his falling. The muscles, under such circumstances, become extremely tender to the touch, some of them remain incapable of being contracted without great suffering, even for months.

Laceration of muscles.

It also sometimes happens that, in consequence of a violent and sudden action of a muscle, some of its fibres are absolutely lacerated; an injury which is attended by instantaneous and intense pain, and from which, in many instances, the muscle never altogether recovers. The *gastrocnemius* and the *sartorius* muscles are particularly liable to this accident; and the sufferer can always point out the precise spot where the muscular fibres have been torn; at which place a distinct fissure may be readily detected beneath the integuments of the limb, especially if the part be examined soon after the accident, and before the laceration is masked by an effusion of blood into the adjacent cellular tissue.

Of the laceration of the muscular fibres of the heart, pathological anatomy affords evidence. The severe character of some accidents which affect the heart, the laceration of the valves, and the rupture of the muscular parietes in diseased hearts, and the formation of aneurism are all examples of this injury of the muscles of the heart.

Now, although we may not have sufficient proof, that all these different changes take place in the muscles of the heart, yet it may be legitimately inferred, that, as these muscles are both voluntary and involuntary, such changes do take place in them; an opinion which is corroborated by various phenomena in the diseases of the heart. But, in establishing an analogy between the muscles of the heart and those of voluntary motion, a remarkable circumstance must be kept in mind, that the muscles of the heart have no repose during the whole span of human life;[1] and also, that their rhythmic action forms a striking contrast to that of voluntary muscles.

Heart's muscles never affected with spasm.

We have no evidence to show that the muscular tissue of the heart is ever affected by *spasm;* nor, indeed, could this have been rationally anticipated; no change having been observed after death in the muscular tissue of those who have died of convulsions or even of tetanus. I am, therefore, disposed to discredit the opinion, or rather the hypothesis, that the heart is subject to *spasm*, and that spasm of the heart is sometimes the cause of death. This opinion has been given in some of those cases where no cause of death could be discovered by dissection; and the vague hypothesis has been often resorted to in order to account for the fatal disease, and to cloak our ignorance of its true nature. If we could for a moment suppose that the muscles of the heart were liable to spasm, so common an affection in the

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[1] "The organic muscles are not subject to those prostrations of force so common to those of animal life."—Bichat.

"But, whilst the voluntary muscles are wearied and pained by too much motion; yet, in acute fevers, the heart is moved with great celerity for many days, without the least sense of pain!"—Van Swieten.

gastrocnemius, arising from a disordered stomach, or inordinate fatigue, is it not probable that spasm of the muscles of the heart would be a frequent cause of death ?

"There are some things," observes the learned Bichat, "which seem to correspond with convulsions, such as the irregularities of the pulse in fevers, irregularities which should be carefully distinguished from such as are caused by organic diseases of the heart, and are quite different to spasms of the voluntary muscles."

Bichat.

Action of poisons on the heart.

How those *poisons*, which act almost instantaneously, destroy life, we have no positive evidence ; but it is probable that they are either absorbed and mixed with the blood ; or that, by their direct influence upon the gastric nerves, they prove fatal by their action on the cerebro-spinal, and on the ganglionic systems ; we may, therefore, infer that it is chiefly by their action on the cardiac plexus that they extinguish life.

Muscles of the heart are exempt from certain diseases.

The muscles of the heart, Bichat observed, are never paralysed, neither in *hæmiplegia* nor in *paraplegia ;* and he was also of opinion, that as only the muscles of locomotion are liable to convulsions, it is probable that the heart is never affected with convulsive movements.

I have already mentioned that the heart's muscles, as well as those of all the other organs of organic life, appear to me to be exempt from *rheumatism*, because an attack of that affection would not fail instantly to prove fatal. It may, indeed, be observed that throughout the whole animal creation means are provided to protect some organs from certain diseases as well as from injuries, which means are multiplied in proportion to the importance of their functions. Thus some are defended from atmospheric agencies by an external covering, or integument ; some by osseous parietes ; some by bony canals ; and some are in pairs, so that if one be injured, the other is sufficient to perform the function for which both were destined. Hence it appears legitimate to infer that the heart of all the vital organs is possessed of an organization, not only to protect it from external injury, and to secure the uninterrupted circulation of the blood through its cavities, but that it is endowed with a structure to render it exempt from some of those maladies to which the organs of animal life are subject.

Morbid changes of the muscular tissue.

Whilst the heart is not liable to some of those diseases, an attack of which would immediately interrupt the circulation of the blood, its muscular tissue is, from its unceasing action, more subject to certain ailments than perhaps any of the other muscles of organic life.

The most remarkable morbid changes in the muscles of the heart are a preternatural *increase*, and a *diminution* in the quantity of the muscular fibres, an alteration in their *consistence*, and also in their *colour*,—the effusion of *blood*,—and the formation of *pus* and of *bone*, in the interstitial cellular tissue. Although morbid growths are rarely met with in the muscular system, *scrofulous*, *schirrous*, *hœmatoid*, and *melanoid* tubercles, are found in the parietes of the heart; some being formed in the muscular, and others in the fibrous lamina both of the pericardium and of the endocardium.

Deposits of *bone* and cysts, filled with a *cretaceous* matter, are not unfrequently found also in the muscular parietes of the heart, especially in gouty subjects. The muscles of the heart, like other portions of the muscular system, are sometimes converted into *fat*, and into matter resembling *spermaceti*.

Increase of the Muscular Tissue of the Heart.

Increase of the muscular fibres.

Of all the changes in the muscular tissue, the most frequent is a preternatural increase in the number of the muscular fibres, or an enlargement of the parietes of the heart.

The voluntary muscles increase in size and in density, in proportion as they are used, in the same manner as they diminish when they are seldom brought into action; but the same change is not met with in the involuntary muscles, unless when the organs to which they belong are diseased.

This probably arises from the circumstance, that when an organ, in the composition of which there is a muscular structure, becomes diseased, such as the urethra or alimentary canal, more powerful muscular contractions being then required to propel the contents of the bladder and intestine, the number of their muscular fibres is increased. This change is remarkable in the muscular tissue of the heart when there has been an increased vigour of its parietes in order to overcome a hindrance to the free passage of the blood through its cavities. An increase of muscular fibres in such cases seems therefore to be a process of the economy—of the *vis conservatrix*—by which, when certain organs have become changed in structure, they are yet enabled to perform more or less perfectly their respective functions.

Different names assigned to it.

An increase in the muscular parietes of the heart, though it had been previously noticed, was first considered as a distinct disease by Dupuytren, by whom it was denominated "nutritive irritation," and by Corvisart, "passive aneurism." Afterwards Laennec called it "hypertrophy," a name signifying an "increased nutrition." This term has since been employed to express, not merely an enlargement of the muscles of the heart, but, in a generic sense, to designate an increase in the bulk of other tissues. An "increase of the nutrition" of a tissue cannot surely be considered as a *disease* or a morbid process. The function of nutrition is constantly varying in every organ, like all the other functions of organic life; so that surely it is an abuse of language to say, that when the bulk of a muscle, or of a bone, or of the adipose tissue, is preternaturally augmented, that such is a distinct disease to which the name of *Hypertrophy* is appropriately applied. Indeed, hypertrophy is a term which appears to me very objectionable, being in no respect preferable to those formerly employed, and equally ill calculated to denominate a genus of diseases, as headache, cough, tenesmus, or palpitation; these terms merely expressing *symptoms*, and symptoms too which are present in almost every disease of the head, of the heart, and of the alimentary canal.

These names objectionable.

Causes which increase the muscular tissue.

There is no disturbance in the functions of the muscles of the heart more frequent than an increase in their action; and this increased action produces an increase in their bulk. The increased action must, however, continue for a lengthened period, before the muscular parietes of the heart are increased in thickness, if we may judge from what takes place in similar circumstances in other muscular sacs, such as in the urinary bladder. At the same time, the heart's muscles having no repose, their bulk must be more rapidly increased than that of most other muscles.

An increased action of the muscles of the heart, and the subsequent augmentation of their fibres, may be produced by several distinct causes.

Inflamed pericardium or endocardium.

When either the pericardium or the endocardium is inflamed, the contiguous muscular tissue becomes irritated, and the action of the heart increased, and in proportion to the degree of the congestion, the muscular parietes increase in thickness.

Congestion.

And whenever either the heart's cavities, or the coronary vessels become *congested*, the muscular parietes are preternaturally excited; the force and frequency of their contractions being augmented in proportion to the difficulty of circulating the blood. Congestion of the cavities of the heart and *coronary* vessels will, I am persuaded, in many instances, account for those cases where there has been an increased bulk in the muscular parietes of the heart without any other alteration in its structure. To this conclusion I have been also led from the mode of treatment by which the congestion may be relieved; and it seems to me extremely probable, that some cases alluded to by that able anatomist, John Bell, were of that description.

"The *heart*, which is so often *dilated* by weakness, is sometimes *reduced* in *size* by an increase of strength and action. It becomes dense, firm, thick in substance, but small in its cavity; it appears to be dilated without, but is in fact contracted within. This thickening of the walls of the ventricles is what I cannot understand, though I have cut many such hearts with the utmost care. There is no ossification of the valves, no straightening of the aorta, nor any other obstruction to excite the heart. There is no enlargement of the auricles, no dilatation of the veins, no disease of the arteries; nothing appears but a thickening, and enlargement, and condensation of the walls of the ventricles, a proportioned enlargement of the columnæ carneæ, and a proportioned narrowing of the cavity of the heart itself. Upon opening such a heart, one would almost pronounce it natural. If one should speculate upon its peculiarities, they would (finding the heart strengthened, and its valves and vessels all sound) pronounce that it would cause rather a vigorous circulation and strong health; yet I shall never forget the miseries I have seen patients endure from having such a heart. They have often a full and bloated habit of body; a pulse weak at all times, but trembling, and hardly sensible, when a fit of difficult circulation approaches; then the pulse vanishes; the patient sometimes faints; the anxieties, oppressed breathing, languid pulse, actual fainting, and all the intermediate conditions less than fainting, but like it, and infinitely more miserable, make their chief sufferings. After struggling long under this disease, the patients grow languid for a few days, often become dropsical, and then die.

"The variety of symptoms which those suffer who have this simplest of all the diseases of the heart is very surprising, and puts to nought all our conjectures about certain signs indicating particular diseases of the heart. We cannot be surprised, that in great enlargements of the auricles, or vast aneurisms of the aorta; or in those enlargements, in which something like polypi are found, and where, as Mr. Holder often said of himself, the circulation seems to go on for a time at one corner, as it were, of the heart; in all such cases, we cannot wonder at there being heard noises like the rushing of water in great cisterns. But how such should be heard in this thickening of the heart, I cannot conceive; yet surely enough one gentleman, whose disease came upon him all at once, and while perfectly at rest, with the sudden sense of something bursting within,—who had, moreover, for several years a palpitation which could be felt outwardly, and a plunging noise, which at times the by-standers could hear very loud; who died in the end in great distress,—had yet none of these ossified valves, enlarged aorta, nor other organic affections, which there was so much reason to suppose, but merely this thickening of the substance of the heart."

John Bell's *Anatomy.*

Diseased valves.

But a long-continued increased action of the muscular parietes of the heart, followed by an increase in their bulk, is frequently caused by a mechanical interruption to the free transit of the blood through the auricular and ventricular cavities; such interruptions being the effects of a morbid change in some portion of the valvular apparatus.

When the muscular tissue is increased, that increase is met with in different portions of the heart, according to the site of the obstruction to the circulation; it may be either in the parietes, or in the fleshy pillars of the valves. The increase of the muscular tissue is chiefly met with in the walls of the ventricles; and more frequently, and to a greater degree, in the systemic than in the pulmonic ventricle; the walls of the left ventricle sometimes acquiring more than double their natural thickness.

When there is an increase in the bulk of the muscles, sometimes there is a diminution and sometimes an increase in the cavities of the heart.

Symptoms.—Reflecting on the symptoms physiological and anatomical which accompany an increase in the muscular parietes of the heart, it will at once appear that as an increase of muscular fibre is not a *primary* disease, but the effect of a morbid condition of some portion of the structure of the heart, or of some change in the quantities or qualities of the blood, the assemblage of symptoms must be varied by that disease with which the changes in the muscles is accompanied. Thus an increase in the muscular fibres is occasioned by a long-continued congestion, causing irritation ; by a vitiated blood ; by frequent and protracted nervous excitement ; or by a mechanical hindrance to the passage of the blood through the heart's cavities ; in each of these cases the increased bulk of the muscular parietes will be attended with symptoms essentially different.

The symptoms arising from an augmentation of the muscular tissue will also vary according to the portion of the heart's parietes which is affected. If it be that of the systemic heart, we may look for those symptoms caused by an irregular circulation of the arterial blood ; and if it be a portion of the pulmonic heart, an assemblage of symptoms will be produced from irregularities in the venous circulation.

To discriminate the portion of the heart's parietes in which the muscular fibres are increased, we must not expect that the local symptoms will give us sufficient information. The symptoms of a disturbed circulation of the pulmonic and of the systemic heart on the different systems of the economy will alone be the means of pointing out an accurate diagnosis.

When the walls of the heart are increased in thickness, there is a proportionable increase in the *impulse;* but from the increased thickening the intensity of the *sounds* is diminished. There is also a dulness perceptible on *percussion*, according to the degree and extent of the increase in the bulk of the heart.

Treatment.—From whatever cause the action of the muscular parietes of the heart may have been preternaturally increased, it is quite clear that the curative indications are to employ those means which tranquillize their action, in addition to such remedies as may be required to alleviate the primary affection by which the increased action of the heart had been excited. If we are able to remove the cause of the increased action of the heart, the number of muscular fibres will gradually diminish in the same manner, as they were increased by unusual exertions.

The decay of the muscular fibres by *rest* is exemplified in all muscles which have not been for some time called into action; and it is extraordinary how greatly the voluntary muscles will sometimes diminish in bulk when a limb has been so much injured that it is unable to be moved for even a few weeks. When, therefore, any of the voluntary muscles are injured, or otherwise diseased, the state of perfect repose into which they are instinctively placed is an essential element in restoring them to health; but the unceasing contractions of the muscles of the heart not only deprive them of the benefit of rest, but become an additional stimulus to any disorder with which they may be affected.

Diminution of the Muscles of the Heart.

Contrasted with an increase of the muscular parietes of the heart, there is a class of affections wherein that tissue is preternaturally *diminished.*[1] The same demand of the economy to increase the muscular parietes in persons, who are exposed to great muscular efforts, not being required in those who lead a sedentary life, the number of the muscular fibres of the heart become diminished; and adipose matter is often deposited in proportion as the muscular tissue has been wasted.

A diminution in the muscular fibres of the heart is met with in various degrees. In some cases the parietes are so thin as to become transparent, especially those of the right auricle; wherein the bundles of muscular fibres are so few, that the exterior and interior membranes are in contact with each other. Bertin.

A diminution in the muscular walls of the heart will be necessarily accompanied with a corresponding diminution of the heart's vigour. This condition of the central organ explains many of those cases of feeble circulation, with all its effects on the different systems of the economy; of which we meet frequent examples.

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[1] "There is a state of the heart the exact reverse of all this, when the flesh of the heart degenerates, where you can hardly recognise it as a muscular structure; and what are we to ascribe this to? Now, this was the case with Mr. Hunter; and as I am a person of a very prejudiced mind, I am persuaded that John Hunter's heart was primarily affected, either from his head, or from the state of his bowels. I have no doubt that he had been long ill, from the state of his bowels; but his heart got into a state, first of functional, and next of organic disease." Abernethy's *Lectures.*

Case

A lady, of an exceedingly feeble frame and of a nervous temperament, complained for a number of years of great weakness, fits of fainting, approaching to syncope, accompanied by symptoms of hysteria. On examining the heart, after her death, there was no deviation from the healthy state apparent, but merely a considerable diminution of its bulk.

Treatment.—The treatment of those cases where there is a feeble heart, is precisely opposite to that which ought to be employed to tranquillize a heart whose muscular powers are too vigorous. That food should be preferred which yields the largest proportion of fibrine, as well as those medicines, such as the preparations of iron, of copper, and of zinc, which improve the qualities of the blood. Muscular exercise should be taken, avoiding fatigue, by which the muscular tissue will be increased.[1]

Softening of the Muscles of the Heart.

The muscular parietes of the heart differ not only in the quantity of their fibres, but the fibres themselves present various degrees of *consistence*, as well as of changes in their *colour*. "Even after death," observes Hunter, "we seldom see a dead body that is not stiff, but very often find the heart large and flabby." They often become flaccid, soft, and easily torn; and in place of the bright red colour of a healthy muscle, they are pale, and sometimes portions of them are of a deep crimson colour. A flaccid state of the muscular tissue of the heart is sometimes accompanied with a diseased condition of the coronary arteries.

In all organs, and in all tissues, a disorganization and *softening* is one of the effects of acute inflammation; whilst a slow passive inflammation produces an increase in the bulk, or a thickening of the diseased tissue, from additional matter being infused into the parenchyma of the inflamed structure.

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[1] "The civilized man is ignorant of his own strength, nor is he sensible how much he loses of it by effeminacy, and how much he might add to it by the habit of vigorous exercise."—Buffon.

That a softening of the muscular parietes of the heart may be caused by inflammation is satisfactorily shown, not only by the febrile character of the symptoms which accompany that change, but also by certain analogous phenomena which are observed in the inflammatory diseases of other organs.

That a thickening of the muscles of the heart should be one of the effects of inflammation, and that a *softening* of them should be another, may appear paradoxical; but it accords with what is constantly remarked in other organs. If a lymphatic gland be affected with *chronic* inflammation, its bulk increases, and it becomes firmer and harder. These changes may proceed until the gland acquires a very large size; after which, either suppuration, or a process of absorption, may take place; so that the gland ultimately resumes its natural bulk. But if a gland is attacked with violent *acute* inflammation, and the degree of swelling be comparatively slight, the gland soon loses its vitality and softens, becoming disorganized, and separates from the living parts in the form of a slough. The inguinal glands frequently afford an illustration of these two very different terminations of inflammation. In one case, the gland becomes hardened and swelled by a very slow inflammatory process, caused by some local or constitutional irritation; and in another case, as sometimes happens in syphilis, a gland in the vicinity of a primary venereal sore, inflames violently, goes through a rapid but imperfect process of suppuration, the superincumbent integuments sphacelate, and ultimately the gland, having lost its vitality, separates from the living parts. Changes precisely analogous are observed in inflammatory affections of the alimentary canal. Those, when acute, such as are caused by the strangulation of a portion of intestine, if the stricture be not duly removed, the inflamed part softens, and terminates in gangrene; whereas, the peritoneum may be inflamed, and the only morbid change which takes place, is the effusion of fibrine on its surface, and in the sub-serous cellular tissue.

From these pathological phenomena we may therefore legitimately infer, that the muscles of the heart, like all other tissues, when affected with inflammation, swell and thicken in proportion to the passive character of the inflammation, and that they lose their vitality, and soften in proportion to the violence of the inflammatory attack.

Changes in colour of the muscles.

It has been already mentioned, that the *colour* of the muscles of the heart is variously changed at the different periods of life; the colour becomes more and more intense as the child advances in life; and in the aged it acquires a yellowish hue.

" In all subjects the muscles are red, but in no two instances is the red of the same shade. The same variety of colour is also observed in the colour of the muscles of the heart." Bichat.

In diseases of the heart the colour of its muscles varies considerably; " in those who die of chronic ailments the muscles become pale and soft; but, in acute diseases, they are very little changed." Bichat.

CHAPTER LI.

DISEASES OF THE TISSUES OF THE HEART.

Dilatation of the heart; rupture of the heart; rupture of the valves of the heart; aneurism of the heart; foramen ovale open; diseases of the cellular and adipose tissues of the heart; differences in the quantity of fat in the heart; its uses in the economy; differences in the size of the heart, and of the quantity of blood contained in its cavities.

Dilatation of the Heart.

All the heart's cavities may be at the same time dilated, or either the pulmonic or systemic heart, or the auricle or the ventricle of either heart, may be alone dilated. The auricles are dilated more frequently than the ventricles, and the ventricle of the pulmonic is more frequently dilated than the ventricle of the systemic heart.

The cavities of the heart dilate in various degrees. Sometimes they acquire three or four times their usual size, and, in some instances, particularly in dilatations of the right auricle, they attain extraordinary dimensions.

"In truth, the distensions of the right heart may give the appearance of an aneurism. But, if we consider the left heart, the disease is more easily recognised, because it is subject to much less variation than the right. The chief difference in the left is caused by its thickness." Bichat

The parietes of the dilated heart may either be increased or diminished in thickness, or they may remain of their natural dimensions. Accompanying the dilatation of the heart's cavities, the great arterial and venous trunks which emerge from the heart are enlarged, and this causes a corresponding change in the position of the valvular apparatus. The cavities of the heart dilate, when there is an obstruction to the free exit of the blood through them, in the same manner as the urinary bladder dilates when there is a strictured urethra, or as the stomach enlarges when the pyloric orifice is contracted. And if any of the valves of the heart be diseased, and obstruct the passage of the blood, the cavities situated above them will likewise become dilated.

"That the heart is enlarged merely by weakness, by wanting sufficient power to free itself of accumulating blood, is very plain; for in the plague, in low and pestilential fevers, even in nervous affections, it sometimes enlarges, and from a temporary becomes a mechanical and fixed disease. How often do we read in the preface of such dissections of enlarged heart: 'He was of a melancholy temperament, of a slow and sedentary life, oppressed by misfortunes, and struggling with vexations and grief?'"[1]

John Bell.

The physiological symptoms.

Symptoms.—The diminished vigour of the circulation in a dilated heart disturbs all the systems of the economy.

The *pulmonary* vessels become congested, and cause an embarrassment in breathing, accompanied with a dry *cough*, which usually comes on in severe paroxysms, and is sometimes accompanied with *hæmoptysis.* The lungs, too, are also compressed by the enlarged heart.

The dilatation of the right heart is marked by the changes in the *venous* system. The external jugular vein, and the veins of the neck and head become enlarged by the reflux of the venous blood from the right auricle. The liver becomes enlarged from a congested state of the portal system, and is frequently accompanied by a hæmorrhoidal flux. The head, neck, and extremities are sooner or later swollen from the infiltration of the cellular tissue.

"The enlarged heart accumulates blood in the system, which before did not exist, and that blood dark coloured and unfit for the purposes of life. The proportion betwixt the great mass of ill-oxydated blood lingering in the veins and about the heart, is increased so very greatly, in opposition to the very small quantity which can now be oxydated in the lungs, that such persons are exposed every moment to the greatest dangers; and the least accident which draws out more black blood from the veins, and hurries it towards the heart, quite overcomes them. Then there is an agonizing and fearful struggle; the heart often struggles, and often frees itself; but in most cases those who live in this condition do, after many escapes, fall down suddenly dead.

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[1] "It is not improbable that the dilatation of organic muscles is a phenomenon equally vital as their contractions. Who knows that one of them may not be disordered separately—that a regular contraction may not succeed an irregular dilatation, and inversely? Who knows whether certain alterations in the pulse, do not arise from disordered dilatation, and others from disordered contractions? One should make this point an object of research!"—BICHAT.

"In this enlargement of the heart, although sometimes there is a perfect and equal pulse, though sometimes also the disease scarcely shows itself until very far advanced, and after many years of slow increase, yet the heart being continually loaded, it cannot free itself at one stroke of all its blood; then, stroke succeeding stroke in a confused irregular way, there is a weak, irregular, intermitting, fluttering pulse.

"But nature, wonderful in her ways, sometimes finds relief from this in the regular constitution of those parts; for while the heart dilates, and becomes more powerless as it dilates, the aorta (being but poorly filled) contracts in proportion as the heart dilates, and accommodates itself to the small quantity of blood which such a heart can give out; and thence the wonder sometimes expressed at finding an aorta extremely slender joined often to an enormous heart." John Bell.

Symptoms.

The *impulse* of the heart is diminished in proportion to the thinness of the muscular parietes, and the fluid blood being a much better conductor of sound than the solid walls of the heart, the weaker and thinner the parietes are the more audible the *sounds*, and the more extended will be the surface of the chest over which they can be heard.

Besides being more audible, the character of the sounds is also changed in the dilated heart. The auriculo-ventricular *valves* are so drawn asunder, that they can no longer perform their proper functions, permitting a reflux stream of blood which must produce changes in the sounds.

Treatment.—The treatment to be employed in dilatation of the heart must necessarily depend on the concomitant changes, and on the causes by which they may have been produced. Relief may be obtained, not only by bodily and mental tranquillity, but also by having recourse to all those means which invigorate the general system, and which improve the condition of the blood. Hence the advantages of cold-bathing and of breathing a salubrious atmosphere, of attention to diet and regimen, and to the use of stomachics and hæmatics.

See Chap. XVI.

Rupture of the Heart.

Many examples of a rupture of the heart's parietes are recorded in medical writings; the walls of the heart being sometimes torn by a violent action of their muscles; in the same manner as sometimes happens to the uterus by those violent contractions which take place during difficult parturition.

"The tenacity of the muscles of organic life," observes Bichat, "is greater than that of animal life. Seldom are any of the muscular fibres of the bladder, the stomach, or of the heart ruptured."

A rupture of the parietes of the heart usually takes place where some disease of the heart had previously existed; but it occurs also when there has been no evidence of any previous change of structure.

The walls of all the different cavities of the heart have been found ruptured, but most frequently those of the left ventricle.

When the heart is ruptured death is occasioned, as from the rupture of an aneurismal artery, more or less suddenly, according to the size of the fissure; sometimes the solution of continuity takes place gradually, the effusion of blood into the pericardium is slow; and in some cases the wound is completely filled up by coagulated blood, and ultimately by an effusion of fibrine, and thus life is prolonged.

When the parietes of the heart have been ruptured, it has usually happened in persons who had been exposed to some great muscular effort, or violent mental emotion. Running quickly, raising a heavy weight, crying loudly, playing on a wind instrument, falling from a great height, a paroxysm of rage, or excessive grief, have all been known to cause a rupture of the heart.

Cases.

"A lady, sixty-five years of age, who had been a long time subject to palpitation, and accustomed to use the warm bath, was advised to use the bath cold, by the addition of ice, and also to put on her head a bladder full of pounded ice; she fell into a state of syncope, she was taken out of the bath, and endeavours were made to restore her to life, but without effect, and she expired. The pericardium was found distended with blood, and a rupture of the left heart, eight lines in length, aortic orifice contracted, and valves ossified." Portal.

"A very corpulent lady had suffered for a considerable time from shortness of breath; after some fatigue from travelling, she was seized with great difficulty of breathing and pain, a full and remarkably unequal pulse. During the night she became worse, and suddenly expired. Pericardium was full of blood, and a rupture was discovered at the base of the heart, near the aortic opening, sufficient to admit the little finger; the heart was in every other respect natural." Portal.

"A man perished suddenly in a violent dispute with one of his comrades. The walls of the ventricle were thin and dilated, with a rupture an inch in length into the chest. At the origin of the aorta there was a cartilaginous tumour, the size of the fist, surrounding the tunic of the aorta, and contracting it, so that it would scarcely admit of the little finger." Portal.

Rupture of the Valves of the Heart.

The same cause which ruptures the parietes sometimes injures other portions of the heart. In some instances the fleshy or the tendinous *columns* are torn asunder, and sometimes the *valves* themselves are lacerated.

Injuries of this description happen not unfrequently. In all those cases where persons have been suddenly attacked with giddiness, reeling, and syncope, after having made some unaccustomed violent exertion, and in whom the circulation is never afterwards perfectly natural, there is good reason to suspect, that one or other portion of the systemic heart has been injured. The valve, torn and displaced, admits a retrograde stream of blood from the ventricle into the auricle; and as the lacerated parts cannot adhere, they never being in a state of rest, all that the economy can accomplish is, to effuse fibrine sufficient to fill up, more or less perfectly, the aperture made by the laceration.

Cases recorded by Corvisart.

A *courier*, after having suffered much fatigue from riding on horseback, was attacked with difficulty of breathing and hæmoptysis. Repeated blood-lettings, and other means, afforded no relief. His pulse became very small and contracted, remarkably frequent and irregular; and besides the pulsations of the heart, there was a confused irregular beating, which had no resemblance to the heart's movements. He could not rest in any posture, and "he was in a state of anxiety and agitation impossible to describe." After death it was discovered that one of the columnæ of the *mitral valve* was torn at its base, thus allowing the valve to float freely in the cavity of the ventricle.

A young man made a violent effort to move a great weight, soon after which a cough, palpitations, and sudden startings during sleep came on. He died twenty months after, having suffered great anxiety, difficulty of breathing, with severe pains in the region of the heart. On examining the tendinous columns of the *mitral valve*, two of them were found torn; and all the cavities of the heart were considerably dilated.

Case recorded by Babington.

"A youth received a sudden shock from the unexpected discharge of a pistol close to his ear. He felt conscious that something gave way in his heart, and from that time suffered from palpitation, occasional syncope, with the usual symptoms of obstructed circulation; and he died of general dropsy at the end of eighteen months. The *mitral valve* was found obstructed by a fringe of excrescences, originating from a rupture of the valve itself, which had taken place at the time of the surprise."

Rupture of the Aorta.

When, from any powerful muscular effort, there is a strong regurgitating stream of aortic blood, it has happened that either the semilunar valves are torn, or when they have been able to resist the retrograde stream, the coats of the aorta have given way.

Case.

A man fell from a window upwards of forty feet high, and in an hour after expired. On opening the thorax, the mediastinum was filled with blood, and there were two fissures at the commencement of the descending aorta, through which the blood had escaped.

Case communicated by Burns.

A youth, after a debauch, from which he experienced, on the following day, great weakness and derangement of the stomach, with a view of improving his condition played at "tennis," which threw him into a profuse perspiration; and, on making a violent exertion, he felt suddenly a giddiness and sense of swimming in the head, so that he could not stand or guide himself without difficulty. He was bled in the arm, and notwithstanding all the means employed the same feelings in the head continued, along with a difficulty in breathing and occasional syncope, but varying in degree, for twelve years, and without any apparent cause he expired suddenly. On inspecting the body, Mr. Burns found that "an *aneurism* of the aorta, not larger than a walnut, had burst into the pericardium, just above the valves."

Aneurism of the Heart.

The dilatation of the parietes of the heart is sometimes limited to a particular portion of one of its cavities, assuming the form of a pouch, and thus constituting a "true aneurism." Such sacculated tumours are formed by the rupture of the interior laminæ of the heart's parietes, and usually from a previous disease of the coats. They occur most frequently in the left ventricle: the violent muscular action which causes the formation of an aneurism, by compressing the arteries, produces a powerful regurgitating stream in the aortic blood, and the ventricle, not being able to empty itself, becomes congested, and its parietes are ruptured.

Aneurisms of the heart have all the general characters of the "true" aneurism of the arteries. They are of various dimensions, and their coats are of various degrees of thickness. The aneurismal pouch is lined with successive layers of fibrine; those contiguous to the interior of the sac are organized, and the interior laminæ are mixed with coagula of blood.

Symptoms.

The presence of an aneurism of the heart, like an aneurism at the arch of the aorta in its very early stage, may be suspected from its history and symptoms; but cannot be recognised with much certainty. Its presence may be suspected, if the patient had previously made some very great and unusual muscular effort, or had suffered any violent mental emotion, immediately after which the circulation was disturbed, especially in the head, causing giddiness, vertigo, and syncope.

It is not until the tumour has acquired a certain bulk that its pulsatory character can be felt, and its whizzing noise becomes audible. In this condition symptoms arise from the aneurismal tumour compressing the adjacent parts. There is a difficulty of swallowing and cough, from its contiguity to the œsophagus and trachea, and there are pains in the arms and parts around the chest, from the pressure of the aneurismal tumour on the spinal nerves.

Treatment.—It is fortunate that the general therapeutic principles which ought to be employed for the treatment of the different morbid changes of the tissues of the heart are, in most respects, alike. In all of them, those means are to be resorted to which tranquillize the heart's movements; for the same reason that rest is recommended as an essential remedy in the treatment of all diseases of the extremities.

This remark strictly applies to the treatment of aneurism. The action of the heart is to be subdued by the abstraction of blood; and, according to the recommendation of Valsalva, the blood should be abstracted only in small quantities, and at sufficient intervals, to render the circulation languid. The same purpose will be further obtained by the use of the *tartarized antimony*, by a low diet, and by the recumbent posture. Immersing the extremities, more especially the superior, into warm water, was strongly recommended by Morgagni; the increased heat of the cutaneous surface thus produced bringing an additional quantity of blood to the skin from the heart. By diminishing the force of the circulation by these means, not only is the growth of the aneurismal swelling diminished, but the coats of the sac are thickened by the deposition of concentric laminæ of *fibrine;* a process of the economy which is accelerated in proportion as the force of the current of the blood in the aneurism is diminished.

Changes in the Foramen Ovale.

The *foramen ovale*, so necessary to the fœtal circulation, is, when it remains open after birth, injurious to the circulation in the adult. In this condition the heart resembles that of an amphibious animal; for whenever these creatures plunge into water, the lungs being no longer wanted as respiratory organs, the venous blood passes directly from the right to the left heart by those channels with which the central organ of the circulation is provided.

"A fœtus being born, cannot live with that heart which served it in the womb; and nature divides the single heart, and there is then a heart for the lungs and a heart for the body. But if any fault in the organisation prevent this separation of the heart —if the foramen ovale be preserved open, or if there should be any hole in the septum betwixt the ventricles of the heart—if the pulmonic artery do not admit the blood now that the child is born, and should breathe the air—if the aorta arise from the right ventricle so as to carry off all the blood from the lungs—or if the aorta be so displaced that its mouth stands in part over both ventricles so as to receive the blood of both—then the organisation, movements, functions of the heart are all wrong; no blood passes into the lungs, the child cannot live; it either dies immediately in convulsive struggles, or lives in misery but a few years." John Bell.

The membrane which covers the *foramen ovale* is sometimes as thin as a spider's web, and resembles a piece of lace; at other times it is found re-opened in such a manner, as to permit an intermixture of the venous and arterial blood. This condition of the *foramen ovale* was first described by Abernethy, but little notice has been taken of it by subsequent pathologists, though its accuracy is now corroborated by morbid preparations in every museum. "Having formerly been much surprised to find the heart so little affected when the lungs were greatly diseased, and observing, in one or two instances, that the *foramen ovale* was open, I was led to pay more particular attention to the state of that part, and I have found this to be almost a constant occurrence in those subjects where pulmonary consumption had for some time existed previous to the person's decease. I took notice of this circumstance thirteen times in the course of one year, and, in several instances, the aperture was sufficiently large to admit of a finger being passed through it. Now, as the *septum auriculum* is almost constantly perfect in subjects whose lungs are healthy, I cannot but conclude that the renewal of the *foramen ovale* is the effect of disease. Nor will the opinion appear, on reflection, improbable; for the opening becomes closed by the membranous fold growing from one edge of it till it overlaps the other; and their smooth surfaces being kept in close contact by the pressure of the blood in the left auricle, they grow gradually together. But should there be a deficiency of blood in the left auricle, and a redundance in the right, the pressure of the latter on this membranous partition will so stretch and irritate the uniting medium as to occasion its removal, and thus a renewal of the communication between the auricles will take place." *Phil. Tr.* 1785.

Diseases of the Cellular and Adipose Tissues.

Morbid deposit in the cellular tissue. It has been already mentioned that many of the morbid deposits in the heart, which are neither formed in the pericardium, in the endocardium, nor in the muscular tissue, are generated in the sub-serous *cellular tissue*, or in the exterior or interior serous membrane; for there is scarcely any cellular tissue amongst the muscular fibres. It is in the cellular and fibrous tissues, interposed between the duplicatures of the endocardium, in which the various morbid deposits on the valves are formed; whilst the ossifications on the exterior of the heart are developed in the cellular and fibrous tissues of the pericardium.

The heart has been found *œdematous;* its cellular tissue, in persons with general anasarca, having the cells infiltrated with a serous fluid, the adipose matter being absorbed. Bertin.

Fat, its different quantity on the heart. The difference in the quantity of *fat* deposited on the exterior surface of the heart of different subjects is very remarkable. The quantity on the heart bears no proportion to that on the rest of the body, lean persons having often the largest proportion of fat on the heart; and it is commonly remarked that all those who die with fat hearts are greatly emaciated.

Not only is there a large quantity of fat on the heart when the body is emaciated, but there is often a very unusual quantity when the heart is diseased. The fat is deposited not only on the heart's surface, but is likewise intermingled with the muscular fibres: this change sometimes takes place to so great an extent, that the whole muscular parietes appear to be converted into fat.

Adams.

The use of fat in the economy.

The purposes which the adipose matter serves in the animal economy have never been satisfactorily explained.

On the fœtal heart there is no fat. In most wild animals there is scarcely any fat on the heart; but in domestic animals, reared for the food of man, fat is deposited in large quantities on the surface of the pericardium as well as amongst the muscular fibres. In those animals which *hybernate*, the fat which they have accumulated in summer is gradually consumed during the state of hybernation, serving for their nourishment. The sub-cutaneous fat is of essential use in all animals, preserving the general heat of the body, and also protecting the internal organs from cold. In the *sturgeon* the heart is enveloped with a thick covering of fat.

The accumulation of fat in the human body proceeds long after the growth of all its other component parts has ceased; rendering it by no means improbable that the additional quantity of fat, with which the aged are provided, serves as a deposit of nutritive matter. But is the fat which is so often accumulated in a large quantity upon a diseased heart intended as a deposit of an element of nutrition? and may it not be one of those provisions of which we see so many examples employed by the economy to preserve and restore its different organs? The accumulation of fat on the heart cannot surely cause any of those serious symptoms which some have attributed to it. The accumulation of fat on the abdominal parietes is an almost constant symptom of a disorder of the liver. To fatten domestic animals, means are employed to disturb the functions of the liver.[1]

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[1] "This necessarily leads me to take notice of the different state of the *adipose* membrane, as giving a considerable difference in the constitutions of man. The different states of the adipose membrane are for the most part abundantly obvious; and the effects of obesity are often sufficiently observable; but upon what internal state of the body, or upon what modification of the economy, it always depends, is not easily to be ascertained."—CULLEN.

How far the elements of fat are changed in diseases, chemical science has not as yet revealed; but, like other component parts of the animal, these elements are probably liable to some morbid changes. In its elementary ingredients, fat seems to vary in different parts even of the healthy body. The rapidity with which the fat of the heart, after being melted, hardens on exposure to cold, may depend on its containing a larger proportion of *stearine* than the fat in other organs.

Differences in the size of the Heart.

The differences which are observed in the size of the heart may either depend on original organization, or they may be the effects of disease. "The bulk of the heart in the dead body varies according to the kind of death. There are cases in which the right heart is much contracted, as in those who die from hæmorrhage. In those who have been 'guillotined,' the heart is found remarkably small, and from syncope. It is also diminished in size in those who die of phthisis. In asphyxia, on the contrary, the bulk of the heart is greatly augmented; and it is the same in the apoplectic. We find in these cases the heart double the size of those who die from hæmorrhage."

Bichat, *Anat. Pathologique.*

There is considerable variety in the size of the heart at the different periods of life, in different persons of the same age, in those of different stature, and in the different sexes.

Neither is the size of the heart in proportion to the bulk of the body. It has been already noticed that fat people, and those who have the least blood, have the smallest hearts; and in muscular men the heart is proportionately large. The heart increases in bulk during the whole period of life, which is contrary to what is observed of other muscles, all which become enfeebled by age. The comparison has been made of the heart being of the size of the fist of the person to whom it belongs.

"No two hearts have in the dead body the same volume, and the variety depends chiefly on the difficulty which the blood has to circulate through the lungs during the last moments of life. Hence, in affections of the heart, we have no type by which we can compare the morbid bulk, above all, when we examine the organ as a whole."

Bichat.

The blood in the heart differs in quantity.

The quantity of *blood* found in the heart after death varies considerably. In all cases where the pulmonary circulation has been interrupted, such as from drowning, poisoning, &c., there is a congestion of the venous blood in the *right heart*—the *ultimum moriens* of Galen, or that part of the body which last dies. Galen found, "on opening the body soon after death, the right auricle filled with blood, and still palpitating."

CONCLUDING ADDRESS.

Having brought this work to a conclusion, I have earnestly to express a hope, that the indulgent reader will not reproach me for its numerous imperfections; and though no one can be more convinced than I am of the many subjects of interesting research left unexplored, yet various reasons have compelled me to offer it to my professional brethren in its present state. "The art of physic is of great extent, life short, opportunity slippery, experience fallacious, and judgment difficult." Hippocrates.

The extensive ground, over which I have been obliged to travel, and the length and the difficulties of the journey, have by no means been overcome by the years that have been employed, and the pains that I have bestowed to render the work worthy of being offered to the public.

The inquiries connected with the diseases of the heart have embraced discussions on physiological as well as on pathological subjects, far more comprehensive than I at first contemplated. In every path of research I was met with difficulties. At one time, the knife of the anatomist had left some regions imperfectly explored; the physiologist had given no satisfactory explanation of some of the most important vital phenomena; and the chemist had not minutely ascertained the nature and composition of some parts of the animal fabric.

In fine, I found that, in the diseases of the heart, every organ, and every system of organs, were more or less influenced; and that a complete Treatise on its maladies, in place of being an isolated subject, should embrace all the elements, and comprise an epitome of medical science.

To surmount these difficulties, and to investigate successfully so many subjects, could not be expected to crown the labours of any individual. Some of the phenomena of the circulation I have endeavoured to trace farther than any of my predecessors; and the explanation which I have given, more especially of a *musculo-cardiac*, of a *pulmo-cardiac*, and of a *veno-pulmonary* function, may be justly deemed an important contribution to the physiology of the circulation. I am persuaded that, since the circulation of the blood was discovered by Harvey, there has been no addition made to our knowledge of the functions of the sanguineous system more likely to lead to the advancement of pathological as well as of physiological science, than the discovery of the musculo-cardiac, the pulmo-cardiac, and the veno-pulmonary functions.

Let me again call the attention especially of the younger members of the profession to the propriety of observing great caution in giving an opinion to the sick, upon the nature and probable termination of their malady, when that malady is of a serious or of a fatal character. A more instructive case than the following cannot be brought before them, to show that an unfavourable opinion, however well founded, may have the most injurious effects on the sufferer, and may frequently hasten the fatal termination of the disease.

George IV., speaking of the duties of a physician, and animadverting in strong language on the impropriety and presumption of mixing his professional duties with those which were distinctly spiritual, said—"I will tell you what happened to Sir Henry Halford with the Queen my mother: Halford was a favourite of the Queen, and although she was quite aware of his oily tongue, yet he made himself both very useful and very agreeable to Her Majesty; and, as a token of her regard, she used to say, that a diamond ring she had got from George III., and which she had ever worn on her little finger, it was her intention to leave to Halford after her death. About eight days previously to that event, Sir Henry had the extreme want of sagacity, and indeed want of proper feeling, to tell Her Majesty that her condition was a hopeless one—that she had but a few days to live—and that, if she had anything to say or settle, it ought not to be deferred. This unwise communication had the worst effect, and caused such a personal dislike to Halford, that she never again alluded to the ring, nor opened her lips, although he continued his professional attendance to the last hour. Such conduct ought surely to be a caution, and indeed a lesson to medical attendants, and a thing, I believe, which never occurs amongst the more enlightened and honourable members of the profession."

The King alluded also to a conversation he had once with Baillie on the same point: though Baillie, in His Majesty's estimation, was a "bear" in his manner, he had sterling good sense, and was a man of kindly feeling. Baillie, on the occasion alluded to, had mentioned to the king that he had once, and only once, told a patient his opinion of his approaching end, and it had so bad an effect, that he did not think himself authorized ever to do so on any future occasion, and he never did so.

Of all things, I have avoided entering into controversial disputes, and have left the reader to adopt or to reject the opinions which I have brought forward according to his own judgment: to prove the correctness and truth of the opinions which we ourselves have adopted, is surely the best mode of correcting the errors of others.

"It is the business of a physician," observed the Father of Medicine, "to make new discoveries in science, or to perfect such as are already made, rather than to spend his time in answering or in depreciating others."

In collecting and arranging the materials of this work, I may safely declare I have never permitted any feelings to govern me but those of an anxious desire to advance the knowledge of the subject on which I have professed to treat; and a fervent hope that my labours, by contributing to the advancement of the healing art, may be useful to my fellow-beings!

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EDINBURGH: T. CONSTABLE, PRINTER TO HER MAJESTY.